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THE ALASKAN TELEGRAPHS.

On another page of this issue will be found an interesting story by Mr. George C. Maynard, of the building of the Alaskan telegraph system. The putting into service of this system during the present year was an important event, giving, as it does, telegraphic communication between this country and its largest territory. As it could hardly be expected that an Alaskan telegraph system would at once prove a profitable investment, it was necessary that the work should be done by the government. It should be noted, however, that General Greely, the present head of the army signal service, believes in utilizing private systems where they are sufficient for the requirements of the government, and only building a government system where this is found to be necessary.

The Alaskan system was first started in 1865. The cable section, starting from Seattle, touches at five other points, the total length being something over 2,000 miles. The land system includes over forty stations, separated from each other by distances varying from three to sixty miles. Wireless telegraphy is also used at one point for transmitting messages a distance of 107 miles. There was no particular difficulty in laying the cable, except possibly the severe storms which gathered. It is worthy of note that this cable was constructed in the United States, and it is said that in operation its results are even better than those anticipated. In running the land lines much difficulty was encountered, both on account of the rough country through which they passed and the severe climate.

THE CHEMISTRY OF ELECTROPLATING.

In a paper on the chemistry of electroplating, read at the recent International Electrical Congress, Professor Wilder D. Bancroft contributes another valuable study in the neglected field of electroplating. This art is carried out to-day generally by rule of thumb, with so-called practical men in charge, who carry on the work merely as they have been taught. A certain procedure has been found to give good results. Why they do not know, and perhaps do not care, since the plater himself, as a rule, knows but little about chemistry and no more about electricity.

Electroplating is essentially a chemical process, the electrical energy being merely a convenient tool for securing the desired deposit. In fact, there would seem to be no need for more electrical knowledge than a good understanding of Ohm's law, the action of a primary cell, and the effect of current density upon the deposits. The problem is really chemical and should be studied in this light. In fact, Professor Bancroft holds that there is a good chemical reason for the action of those substances which are found to give good deposits when added to the plating solution. Thus, to point out one or two of the conclusions, it is held that a bad deposit is due to the precipitation of the metal with some salt or non-metal. Therefore the addition to the solution of anything which will dissolve this salt or non-metal will tend to prevent its precipitation and to improve the quality of the deposit. This reasoning seems sound. A chemist would probably say, "Why, of course, that is why they were added," yet in most cases these solutions were found by the method of trial and failure. Professor Bancroft also considers the effect of current density and temperature solution upon the fineness of the deposit, holding that the action is entirely similar to that which takes place when depositing crystals from a solution. While all who took part in the discussion after the reading of the paper did not agree with the author in all of his conclusions, they all agreed upon the desirability of studying the chemistry of this as well as other processes which, while designated as "electrical," are really mainly chemical.

TRANSFORMER ACTION.

To the layman the action of the electric transformer is wonderful and incomprehensible. To the electrician it is not less wonderful. The former probably believes that the mystery of this apparatus is concealed within its iron case. The latter is familiar with its construction, and to him the mystery is more deeply hidden, and there is less hope of its complete explanation. It is not difficult to explain in popular terms the electrician's idea of what is going on in the transformer.

The electric transformer is a device for changing electric pressure. For some purposes a high pressure, but a small flow of electricity, are most advantageous. For others it may be desirable to have a lower pressure, but a larger quantity. Thus, using an analogy, in operating pneumatic tools it is better to use air at a high pressure, since we will then be able to do the necessary work with a smaller quantity; but for ventilating a building a large volume of air must be supplied, and this should be done at a low pressure. Supposing, for some reason, it were desired to ventilate a building, and that it was thought advisable to obtain the power necessary for this from compressed air supplied from a distance. The plan adopted would probably be to drive, by means of high-pressure air, a machine which would set the air throughout the building in circulation. This ventilating machine would correspond, in a sense, to a transformer, but this analogy should be viewed rather as an illustration of what the transformer does, rather than how it does it. No mechanical or pneumatic or hydraulic analogy of electric action is entirely satisfactory.

The electric transformer, then, is an apparatus which by means of a small electric current at a high pressure causes a larger electric current at a lower pressure to circulate; or, since the apparatus is reversible, the opposite action may take place. When used in the first way it is designated as a step-down transformer, and when applied for raising the pressure it is known as a step-up transformer. The construction of the transformer is the same whether it is used for stepping up or stepping down, but the case and other accessory devices may be modified to meet the conditions of the locality where it will be installed.

The action taking place in a transformer is explained by the electrician as follows: it will be necessary to go back to two fundamental facts, neither of which can itself be explained. The first is the fact that when an electric current flows along any path, the material constituting this path acts as a magnet. The second is that if magnetic conditions about any object be varied, there would be a tendency for an electric current to flow in that object. The electrician states this by saying that an electric current sets up a magnetic field around its conductor and, conversely, that if the magnetic field around a conductor is varied there will be a tendency for an electric current to flow in that conductor. A transformer is merely an apparatus for utilizing these two actions. An electric current which varies in strength is sent through a coil of wire, thereby setting up in the neighborhood of that coil a magnetic field which varies as the current varies. A second coil of wire is placed near the first—that is to say, within the magnetic field set up by the first. The varying field produced by the varying current in the first coil will have a tendency to cause an electric current to flow in the second coil; and if there is a suitable path a current will flow. Why this should be so we do not know, for therein lies the mystery to the electrician. Any explanation offered consists merely of the statement of this action according to our necessarily indefinite ideas of what electricity, and the medium through which this action takes place, are.

It should be noted that, in order that a current may be set up in the second coil or wire, it is not merely necessary that a current should flow through the first, but the current in the first must be one which varies in strength, because the current in the second coil is due not to the fact that it lies in a magnetic field, but that it lies in a varying magnetic field.

The means by which the electric pressure in the second coil is made different from that in the first is very simple. The pressure in each coil is proportional to the number of turns of wire in that coil. Thus, if we supply a current to the first coil at an electric pressure of, say, 1,000 volts, and this coil has ten times as many turns as the second, the electric pressure set up in the second coil will be one-tenth of that in the other, or only 100 volts. On the other hand, since we must take out of the second coil as much power as we put into the first coil—neglecting the losses which necessarily take place in any contrivance—the current flowing in the second coil will be approximately ten times as great as that which passes through the first coil. It may be said that the power supplied to any electrical device is approximately equal to the product of the pressure and the current flow.

The transformer then consists essentially of two coils of wire placed close together. In order to keep these devices as small as possible it is necessary that the magnetic field set up should be as intense as possible, and this is accomplished by placing the two coils on a ring of iron, usually built up of iron stampings. Further, since the low-pressure coil carries a larger current than the high-pressure coil, the cross-section of the wire used in the former is always larger.

The transformer is one of the most important devices used in electrical work. At the same time, it is one of the simplest and one of the most efficient—that is to say, for a given amount of power supplied to it it will pass on a larger proportion than almost any other device. While simple in principle the construction frequently becomes complicated, because of the precautions which must be taken to confine the electric currents to their proper paths, and because of the desirability of keeping the devices as small as possible. It is upon this apparatus that the success of the alternating-current system depends, since, by means of it, small quantities of electricity at high pressure can be transmitted from point to point with small loss, and then transformed to larger quantities at low pressures suitable for human use.

THE GAS TURBINE.

The mechanical simplicity of the ideal steam turbine appeals strongly to the engineer. On the other hand, this device is operated by a process which is inefficient. The chemical energy of coal is first transformed into heat, this is then transferred to water, converting the latter to steam; and the steam, converting part of its heat energy into kinetic energy, transfers part of the latter to the turbine. Why not eliminate the steam part of this operation and transfer the energy from the gases, which is in the form of heat, directly to the turbine itself? In other words, why not construct a gas turbine?

The idea is by no means new. In fact, attention was called to this possibility about the middle of the last century, and a patent for such a device was applied for in Germany more than forty years ago; but at that time the need for improving the efficiency of our prime movers was not so pressing as it is now, and the mechanical difficulties of constructing a gas turbine probably seemed insurmountable. However, since the steam turbine has been brought to a condition where it now promises to take a large part in the future development of electrical industry, the gas turbine is again receiving consideration, in the hope that the knowledge gained in the development of the former may enable us to obtain at least some idea of the possibilities of the latter. This interest is not confined to one place, and it is rather significant that, during the past week, three independent discussions of the gas turbine came to hand. At a recent meeting of the Institution of Mechanical Engineers, of Great Britain, Mr. R. M. Neilson read a paper entitled "A Scientific Investigation into the Possibilities of Gas Turbines," an abstract of which will be found on another page of this issue. In the current number of the *Engineering Magazine* there is a discussion of the work of Messrs. Armengaud and Lamale, a description of which appeared in our last issue, an account of which appeared in a Swiss journal; and in the *Electrical Engineer* (*London*) for October 21 there is a note on this subject, in which the work of Dr. S. F. Stolze, of Charlottenburg, is described briefly. It was Dr. Stolze who applied for the German patent, mentioned above. This was granted but recently, and a 200-horse-power turbine is now being constructed according to his designs.

The paper by Mr. Neilson discusses a number of ways in which the fuel energy may be converted into mechanical energy by means of the turbine. He finds that several of these processes give high ideal efficiencies, but that they would be difficult, if not impossible, of application on account of the limitations of the material which must be used in constructing the turbine. A high ideal efficiency goes with a high temperature of combustion. From considerations of efficiency alone it would seem desirable to have this maximum temperature as high as 2,000 degrees centigrade, but Mr. Neilson thinks that, from considerations of the material which can be used, the temperature in the turbine should not be more than 700 degrees centigrade, unless means is provided for cooling the turbine blades. If cooling be adopted, the efficiency of the process is lowered. If the gases be cooled before coming in contact with the turbine blades by means of a diverging nozzle, such as is used in several types of steam turbines, the velocity attained by the discharge gases is too high to be utilized economically in any form of turbine we are able to construct to-day. These difficulties suggest certain modifications, such, for instance, as cooling the gas by means of water, and using the steam thus generated either to drive another turbine, or mixing it with the burned gases and using it in the same turbine. A process of this kind lowers the ideal efficiency and increases the volume of the working fluid, but it may permit a higher practical efficiency to be obtained. Mr. Neilson concludes that there are several cycles which offer possibilities of success. What the probabilities are can not be determined from lack of experimental knowledge, and directions in which such investigations should be carried out are indicated.

It is rather interesting to note that Mr. Neilson's cycle 3—that is, the one in which the temperature of the gases is cooled by causing them to produce steam—is the one which is being used in the Armengaud-Lemale and the Stolze turbines.

Undoubtedly we are in a better position to-day to develop a satisfactory gas turbine than we were when it was first proposed to construct a steam turbine. It should be remembered that it was many years after an engine of this description had been constructed before it even received any recognition. Whether the same fate awaits the gas turbine we can not say, but it hardly seems probable; nor, on the other hand, does it seem likely that the steam turbine will be discarded shortly. However, should the unexpected happen, the engineering ability and money which have been expended in bringing this machine to its present state will not have been wasted, for the success of the gas turbine will depend largely upon our experience in the construction and operation of its steam brother.

SUBWAY VENTILATION.

The report circulated in one of the New York papers that the ventilation of the subway is insufficient and the air there is very poor in oxygen need cause no anxiety. The method by which this has been determined is questionable, and it is probable that the samples of air were taken too soon after the subway was started to give a fair test of what conditions will be when they have settled down to normal. The fact that a large difference was found in certain of the samples of air taken at different points would seem to show that this is not yet so. It will be an easy matter to have the quality of air tested carefully, and should it be found that the movement of trains does not produce as much ventilation as was hoped, it will not be difficult to install fans at proper points and thus rectify the matter. It should be remembered that the subway is an enclosed space, and hence, like any occupied building, will contain, under normal conditions, a smaller percentage of oxygen than will the free air outside. It should also be remembered that carbon dioxide is not an active poison, but is merely a neutral gas. Air which is poor in oxygen is not necessarily injurious, as its fault lies merely in the lack of a desirable quality.

A Scientific Investigation of the Possibilities of Gas Turbines.

At a recent meeting of the Institution of Mechanical Engineers, of Great Britain, a paper entitled "A Scientific Investigation of the Possibilities of Gas Turbines" was read by Mr. R. M. Neilson. In this paper the author considers various methods of converting the chemical energy of gas into mechanical power by means of a rotating engine or turbine. The subject is treated by determining the highest possible efficiency through an application of Carnot's formulæ for the efficiency of an ideal heat engine. At the same time, the amount of negative work—that is to say, the work which must be done on the gases before combustion takes place, and in order to drive them out of the engine—must be determined.

In applying Carnot's cycle, it should be remembered that all the heat is put in at the higher temperature, and all is withdrawn at the lowest temperature. This is a condition seldom obtainable in practice. An increase in the range of temperature does not necessarily cause a thermodynamic gain, and it is possible largely to increase the range of temperature—as, for example, by superheating the steam before use in a steam engine—without thermodynamically increasing the efficiency more than a small percentage. We should seek, not so much to get the maximum and minimum temperatures, respectively, as high and as low as possible, but to get the mean temperature at which heat is given to the gas and the mean temperature at which heat is withdrawn from it, respectively, as high and as low as possible. Of these two temperatures, the lower one is usually by far the more important. An ideal gas engine, working on Carnot's cycle between limits of temperature of 2,000 degrees absolute and 300 degrees, will lose as much by an increase of 100 degrees to the lower as it will by a decrease of 500 degrees from the higher temperature.

Considering the process applicable to gas turbines, there are four cycles on which it seems to the author that these could be worked with a possibility of good results. These four cycles are taken up serially, and under each several cases are considered.

In cycle 1 the working fluid is compressed adiabatically. Heat is then supplied by a combustion at a constant pressure. The gas expands adiabatically, and the fluid is cooled at a constant pressure. Reciprocating gas engines have been worked on this cycle, but they have never become common. The engine whose cycle most closely approaches this is the Diesel, but here there is no decided constant-pressure line. If the fuel and air are brought into contact only on entering the cylinder, it is difficult to get perfect combustion during a period of constant pressure. If the air and fuel are mixed previously, the charge will fire back occasionally. In applying this process to gas engines, the air and fuel may be brought together in a nozzle which thereafter diverges, with the idea that the air and fuel combine on meeting, and the products of combustion will acquire a high velocity in the divergent nozzle, with which velocity they are directed against the turbine buckets. The author doubts if combustion under this condition would be quick enough to give a good efficiency. If combustion takes place previously in a chamber of large size, from which the hot gases are conducted to the turbine, better results might be expected. There should not be as much difficulty in applying this cycle to a turbine as when it is attempted to work reciprocating engines to it. One advantage obtained by the use of the turbine will be the absence of hot waste gases mixed with the fresh air and gas to be compressed. This cycle allows a fairly high ideal efficiency to be attained with a moderate maximum temperature. The latter point is of great importance if it is desired to use a turbine of the Parsons type. A Parsons turbine could probably be designed to withstand a temperature at its blades of about 700 degrees centigrade without cooling.

CYCLE I.

If the gas is to be used in a Parsons turbine without cooling arrangements, the maximum temperature must not exceed 700 degrees centigrade. If the initial temperature be seventeen degrees centigrade and the initial pressure be fifteen pounds absolute, and if the gases are first compressed to forty-two pounds absolute, the absolute temperature will be about 389 degrees. Let combustion then take place until the temperature has reached 973 degrees absolute. Then the gases may expand adiabatically until the pressure falls to fifteen pounds absolute, and the fluid be exhausted into the atmosphere. It is found that the ideal efficiency of this cycle is 0.25, and the ratio of the negative work to the gross work is 0.4. In case 2 of this cycle it is assumed that, by means of cooling devices, an initial temperature of 2,000 degrees centigrade is allowable. Some cooling arrangement must be devised, but there should be no great difficulty in passing water through the rings which support the moving blades in a way similar to that adopted by Mr. Parsons for heating them by means of circulating steam. This case, which works between the same pressures as case 1, gives the same ideal efficiency, but reduces the ratio of the negative work to the gross work to 0.17. In case 3 of cycle 1, it is assumed that higher compensation will be allowable. Let this be 300 pounds per square inch absolute. The temperature at the end of compression will then be 682.5 degrees absolute. Allowing the maximum temperature after combustion to be 2,000 degrees centigrade, as in case 2, the ideal efficiency is found to be increased to 0.58, but the ratio of the negative work to the gross work has been increased to 0.3. In case 1 the ratio of the negative work to the gross work was 0.4. What will be the efficiency if the same ratio of negative work to gross work is allowable, with a maximum temperature of 2,000 degrees centigrade? It is found, case 4, that this will give an ideal efficiency of 0.68.

In case 3a of the cycle, instead of cooling the turbine by means of circulating water, as assumed in case 3, the temperature of the gases may be reduced by previous expansion in a diverging nozzle. More than one nozzle may be employed, but to reduce the radiation losses the nozzles should be large and few in number. Suppose the gas is compressed adiabatically to 300 pounds absolute, and is then heated at constant pressure to a temperature of 2,273 degrees absolute, as in case 3. Now, let the gas expand in a suitable nozzle adiabatically until the pressure falls to fifteen pounds absolute. The temperature will be 966 degrees absolute. This is just below the temperature fixed as a maximum for a turbine without artificial cooling—that is, 700 degrees centigrade. The efficiency will therefore be the same as in case 3, and the ratio of the negative work to gross work will also be the same.

The velocity of the gas as it leaves the nozzle is 5,290 feet per second. The velocities of the steam jets employed in De Laval steam turbines are less than this, for if operated with saturated steam at fifty pounds absolute expanded to a pressure of 0.6 pounds absolute, the velocity acquired is 3,690 feet per second. If saturated steam at 300 pounds absolute were treated similarly, the velocity would be 4,380 feet per second. To get the best results from a fluid velocity such as 5,290 feet per second would require a single turbine wheel with a vane speed which can not be obtained at present for

want of a sufficiently strong and light material.

The frictional losses in the nozzles of a gas turbine will probably be less than those in a steam turbine with the same velocity of exhaust from the nozzle.

Case 4a, let the gas be compressed until the ratio of the negative work to gross work is 0.4, as in case 4. The pressure is 818 pounds absolute. Let the maximum temperature be 2,000 degrees centigrade. Let these gases after combustion expand in a divergent nozzle to reduce the maximum temperature to 700 degrees centigrade, so that the gas can be used in the turbine without cooling arrangements. The gas is then further expanded in the turbine. The pressure, as it enters the turbine, will be forty-two pounds absolute, and the loss of pressure in the turbine may be twenty-seven pounds. The velocity will be 5,280 feet per second. The ideal efficiency will be 0.68, being the same as in case 4.

It seems to the author that an engine on this cycle, according to the last two cases or between them, has good prospects. The ideal efficiency is high—from 0.58 to 0.68—though how near one could approach this in practice would depend upon the losses in the motor proper and on the losses in the pump. The losses in the motor would consist of radiation and conduition, fluid friction, bearing friction and incomplete expansion. The first will be large, but should be less than in turbines using saturated steam. The third will be small, and the fourth loss should be moderate. It is difficult to estimate pump losses, but a fairly efficient rotary air compressor should not be an impossibility.

While the ratio of the negative work to gross work is high, the bulk of the turbine would probably be small for its power.

CYCLE II.

In cycle 2 it is supposed that the fluid is compressed adiabatically to, say, 101 pounds per square inch absolute. The temperature is then 500 degrees absolute. It is then heated at constant volume by explosion, the mixture being such that the temperature rises to 200 degrees centigrade. The pressure will be 459 pounds absolute. The gas is allowed to expand adiabatically until its pressure is atmospheric, when its temperature will be 855 degrees absolute. It is cooled at that pressure until it resumes its original state. This cycle gives an ideal efficiency of 0.55, and a ratio of negative work to gross work of 0.23. The cycle very nearly resembles the common practice of to-day with reciprocating explosion engines. The expansion, however, is continued to atmospheric pressure, which is not desirable in a reciprocating engine, on account of the extra length required to be given to the cylinder.

This gas could not be allowed in an uncooled turbine at the maximum temperature, but if expansion were performed wholly or nearly wholly in a divergent nozzle, the temperature exit from the nozzle would be sufficiently low to allow the gases to enter an uncooled turbine. Let this be 700 degrees centigrade. The mean pressure on leaving the nozzle will be 23.5 pounds absolute, and the mean velocity will be 4,120 feet per second.

These two cases of cycle 2 give higher efficiencies than cases 1 and 2 of cycle 1, but the ratio of negative work to gross work is greater. The efficiency is nearly as great as in case 3 of cycle 1, but is considerably less in case 4 of the same cycle. There are two objections to the use of cycle 2 for turbines which must be set against the advantage which turbines possess over reciprocating explosion motors. One of these is that explosions at constant volume have to take place intermittently, while a turbine desires a continuous supply of fluid. If this supply is not continuous the power of the turbine is less than it would otherwise be for a given size of machine, and the initial cost of the bulk, and, most important, the loss of friction, are greater in proportion for the power developed than they would otherwise be. The other objection is that the fluid must leave the explosion chamber at varying pressure. This necessitates the fluid entering the turbine casing either at varying pressure or varying velocity, which is objectionable, as the speed of rotation during the period of a cycle can not be made to vary correspondingly. The latter objection might be met by employing a parallel-flow turbine of the De Laval type, having long radial blades, and causing the nozzles to be altered in position according to the pressure, directing the gas against the outer ends of the blade at high pressure and against the inner ends at low pressure. The difficulty could also be met by first expanding the gas in a reciprocating engine to a certain pressure, and then passing it to the turbine to complete the expansion.

Let cycle 2 be adopted, but let the compression be carried to 818 pounds absolute, as in case 4 cycle. One obtains with a maximum temperature of 2,000 degrees centigrade a maximum pressure of 2,045 pounds absolute. This gives a high ratio of negative work to gross work. Assume, then, a lower compression of only 417 pounds absolute. Working with the same maximum temperature—2,000 degrees—the maximum pressure will be 1,265 pounds absolute, the ideal efficiency will be 0.68, and the ratio of negative work to gross work 0.38—that is, the efficiency is the same as case 4, cycle 1, where a compression of 818 pounds absolute was assumed. The ratio of negative work to gross work is also the same. In this case the excessively high maximum pressure is objectionable.

If the expansion take place in a divergent nozzle until the temperature falls to 700 degrees centigrade, the gas will still have a pressure of seventy pounds absolute, or the mean velocity of exit from the nozzle will be 4,300 feet per second. If the gas be expanded down to twenty-five pounds absolute, the temperature will be 741 degrees absolute, and the mean velocity will be 4,380 feet per second.

CYCLE III.

It has been proposed, when a water jacket is employed, to utilize the heat passed into the jacket by causing this to generate steam from the water. This steam could then receive further heat from the products of combustion, which would, therefore, be reduced in temperature, while the steam would be superheated, and the steam and product of combustion could then expand adiabatically, doing work in the same or in separate turbines. This plan would affect the efficiency in several cases considered of cycle 1. Cooling arrangements are not required in case 1 in cycle 1, so this need not be considered. In case 2 of cycle 1, let it be supposed that the combustion chamber is jacketed, and the jacketed water is heated and converted into steam by heat taken from the products of combustion, which have their temperature thus lowered from 2,000 degrees centigrade to 700 degrees centigrade—the temperature at which they can be allowed in an uncooled turbine. The portion of the heat which can now be converted into work will not be as great as in the original scheme, since some of it is carried off in the exhaust steam. This transfer of heat from the gas to the water lowers the ideal efficiency, but since, in any case, a large amount of heat must be lost in practice when the products of combustion enter the turbine casing at a temperature such as 2,000 degrees centigrade, it may be that when the temperature is lowered by generating steam, rather than by the use of a water jacket, a higher working efficiency will be attainable.

Case 3 of cycle 1 could be modified and

the temperature reduced by the generation of steam as just considered. The maximum temperature may be reduced to 700 degrees centigrade by employing the heat so given up in heating water and generating and superheating steam up to, say, 300 pounds absolute, the same pressure as the products of combustion, and superheated to 700 degrees centigrade at this pressure. The steam and gas could then be expanded adiabatically in the same or in separate turbines. The ideal efficiency would be reduced to 0.33, and the ratio of negative work to gross work would be increased to 0.41. However, the practical efficiency might be largely increased, as the various steps in this cycle would be as follows: The gas is compressed until its pressure is 300 pounds absolute and its temperature is 409.5 degrees centigrade. It is then heated by combustion at constant pressure until its temperature is 2,000 degrees centigrade. Heat is then withdrawn at constant pressure and transferred to the water and the steam, the temperature of the gas falling to 700 degrees centigrade. The gas then expands adiabatically until the pressure is fifteen pounds absolute, and the temperature is 140 degrees centigrade. The ideal efficiency is 0.33, the loss as compared with case 3 cycle 1 being due to the relatively low efficiency of the steam cycle, which is only 0.28. The latter efficiency, however, is not low for a steam engine.

Cycle 2 could be modified in the same way as cycle 1, by combining steam with the gas. However, case 2 of cycle 1 could not be so treated.

All of these cycles might be modified by extending the adiabatic expansion line below atmosphere. This would require compressing the fluid back again to atmospheric pressure; but this compression is isothermal or between isothermal and adiabatic, and there will consequently be an increase in the efficiency.

CYCLE IV.

The fourth cycle considered is one in which an ideal efficiency can be obtained at a low compression and without having an abnormally high ratio of negative work to gross work. In this cycle let the fluid be at 1,592 degrees centigrade and the pressure at thirty pounds absolute. Now let combustion take place at constant pressure until the temperature reaches 2,000 degrees centigrade. Then let the gas expand adiabatically until the pressure is atmospheric. The temperature will be 1,592 degrees centigrade. Now pass the gas through a regenerating chamber and cool it at constant pressure until the temperature is eighty degrees centigrade. The gas escapes into atmosphere and cools at constant pressure to seventy degrees centigrade. A new charge of gas is taken in and compressed adiabatically until the pressure is thirty-five pounds absolute and the temperature eighty degrees centigrade. The fluid is then passed through the regenerating chamber and is heated at constant pressure until it reaches the starting point. In this cycle the ratio of negative work to gross work is 0.16, the ideal efficiency being 0.84. The ideal efficiency is high, but the highest actual efficiency obtainable would probably be much below this, since there would be great loss in the regenerator. It would not be practical to reduce the temperature of the exhausting gases in the generator to eighty degrees centigrade nor to raise the temperature of the fresh gases in the regenerator to 1,592 degrees centigrade. If the losses in the regenerator and in the passages leading to it and from it amount to fifty per cent of the heat which is ideally given in or taken from the regenerator, these losses would have to be made up by extra heat given to the fluid by combustion, and the efficiency would fall to 0.3. This does not take into account the losses in the motor proper and in the pump. This cycle may, however, give sufficiently good results when used with turbines to justify its use. It promises better results with turbines than with reciprocating engines. The disadvantage of this cycle is that gas at a very high temperature has to be conveyed from the regenerator to the turbine. This forces us to have the turbine close to the regenerator, and it would be necessary to build the regenerator of brickwork, and to build the turbine into this brickwork—a construction which would very much limit the usefulness of the cycle.

Comparing the several cases considered, it is seen that high ideal efficiency is, as a rule, accompanied by a high ratio of negative work to gross work. Cycle 4 is, however, an exception to the rule, as it has the highest ideal efficiency and the lowest ratio of negative work to gross work. This method of lowering the maximum temperature can be applied to other cases. Thus, with cases 1 and 3 of cycle 1 there should be no necessity of using a regenerator of brick or such like refractory material. There are, of course, many other cycles and modifications which might be investigated.

Although the practical efficiency of an engine is usually of great importance, there are many occasions on which very poor efficiency will be tolerated if other conditions are satisfactory. If small gas turbines were sold at a low price, and if they required little attention and did not readily get out of order, they might be in great demand, even though the gas consumption per brake-horse-power-hour were high. When the average use is not more than 100 brake-horse-power-hours per week, a reduction of $50 in the initial cost is of more consequence than a reduction of two cubic feet per brake-horse-power-hour in gas consumption. Many would be willing to allow an additional five cubic feet of gas per brake-horse-power-hour if thereby they were saved considerable trouble and anxiety, and the expenses in the working of the engine were small.

To produce a gas turbine cheaply it would seem necessary to avoid entirely reciprocating parts and to be content with a low compression. Cycle 1, case 1, seems to lend itself to cheapness of contruction and simplicity, but it might be advisable to reduce the compression at the expense of efficiency. A rotary pump could undertake the compression. It is suggested that a suitable field for the gas turbine would be on motor cars, since the vibration of the reciprocating engine is extremely objectionable there. They might also be used for individual driving of machine tools in shops, if the construction were such that they could be set down anywhere like an electric motor. The power of the gas engine might be varied with an insignificant variation of the speed by cutting out one or more of the nozzles or admission ports. If one flame supplied all the nozzles or admission ports, it would be necessary to control the fuel and air supplies to the flame in conjunction with the mechanism which cuts off the nozzle or admission ports. It will, however, usually be advisable to supply the air and fuel to the flame at a constant velocity, and although this could be done when one flame supplies a varying number of nozzles, it might be expedient to have a separate flame and a separate combustion chamber for each nozzle.

A satisfactory comparison of the various cycles and cases is difficult, because of the lack of experimental data. The following points should be investigated: losses in pneumatic compression to high pressures with reciprocating compressors, with rotary compressors, or with a combination of these two; the expansion of hot gases in diverging nozzles; and radiation losses and transference of heat from gases to metals at high temperatures. A thorough set of experiments on these three points would aid immensely in solving the gas turbine problem, and the expense necessary for this would be small compared with the importance of aiding in the production of a successful gas turbine.

The Alaskan Telegraph.

An Historical Sketch of a Noteworthy Achievement in the Building of Government Telegraph Lines. The Story of the Alaskan Telegraph from Its Inception in 1865 to Its Successful Working in October of 1904.

By George C. Maynard.

THE Alaskan telegraph was commenced by Frank Pope in 1865 and finished by General Greely in 1904. The pioneer work on the great undertaking is worth a long story, but it can have only a brief word here. Under the pressing need of telegraphic communication between the new world and the old, Perry McDowell Collins started a gigantic enterprise which contemplated a system of land and submarine lines reaching from Vancouver up to the northwestern tip of the continent, across Bering Strait, and through Siberia to Moscow. Bering Strait is forty miles wide; from that place to Vancouver is 1,800 miles, to Moscow 7,000 miles. Collins secured government concessions, provided funds and sent out numerous exploring and construction parties under the general direction of Charles S. Bulkley. Franklin Leonard Pope was in charge of the explorations of the American division and his brother Ralph was one of his assistants. George Kennan was in the Siberian party. His experience at that time led him to much more extensive experiences in Russian affairs at a later time. If the telegraphic enterprise of 1865 had been carried to success, and permanent communication between the greatest of republics and the biggest of empires been established, Kennan would not now be barred out of Russia and engaged in writing news of her wars—and Russia would not have a war for anybody to write up.

For a year and more work on the overland line went forward vigorously. Routes were selected and cleared, shiploads of material were forwarded and distributed and considerable stretches of line were put up. At the works of W. T. Henley, in London, 525 miles of cable for the Bering sea section was manufactured and shipped. The deep water portion of this cable was a little smaller than the first Atlantic cable (one-half inch in diameter), the shore end measured one inch. It is stated that this cable is now in service somewhere in the East Indies.

In the midst of the work came tidings of the successful completion of the Atlantic cable, rendering overland communication unnecessary, and the undertaking was abandoned, or rather it was laid aside to wait until science and civilization should catch up with American enterprise. Since that time Bering sea has been the objective point of the telegraph from both directions. Russia, under the constant stress for military domination, has forced its lines to the Pacific; while the United States, filled with the spirit of humanitarian development, has steadily pressed forward into the northwestern land. It is a significant fact that, while the Alaskan telegraph has been built by the war department, primarily as a military measure, it has been regarded from the outset as a temporary expedient, with the intention of turning it over to private companies just so soon as they are ready to undertake its maintenance and furnish the government the service it requires.

GENERAL A. W. GREELY, CHIEF SIGNAL OFFICER, U. S. A.

When General Albert J. Myer was at the head of the Army Signal Service, and the telegraphic transmission of weather reports was commenced, he strongly favored the permanent establishment of a government telegraph system, and not only wished to have it put under his management, but advocated the purchase by the government of all the telegraph lines in the country and the placing of them under his control. At that time Lieutenant (now Brigadier-General) Greely was attached to the signal service but did not share the views of his chief on this point. He has now been the chief signal officer for nearly twenty years and has brought the service up to the highest degree of efficiency and reliability. He undoubtedly understands the subject of the transmission of intelligence in the army better than any other person. He is charged with the duty of providing means of instant communication between all portions of the army at all times. He believes in utilizing the facilities of private telegraph and telephone companies where these are sufficient for the requirements of the government, and in building lines where necessary. The Alaskan lines have been established in pursuance of this policy, and whenever the amount of business in this territory becomes sufficient to warrant the maintenance of commercial lines these military lines will be replaced by private companies.

The plan of the government, as determined by legal enactment, provided for by congressional appropriations and carried out by the officials of the signal corps, contemplated the establishment of a complete system of land lines, aerial lines and submarine cables which should bring, by routes entirely on American territory, every military station in Alaska into telegraphic communication with the headquarters of the Department of the Columbia and, through facilities furnished by connecting commercial lines, with Washington and the rest of the world.

The country through which the Alaskan lines run probably presents as many difficulties as any portion of the world. A few of its picturesque characteristics are mountains towering into the skies; unfathomable gorges; impenetrable forests; glaciers and avalanches that rival all Europe; rivers wide, deep and swift; immense unexplored and uninhabited regions; winter weather that makes nothing of sending the thermometer down to — 60 degrees Fahrenheit. General Greely, in reporting the completion of the work, says:

"It will be admitted that the undertaking is unique in the annals of telegraphic engineering, whether one considers the immense extent of territory, its remoteness from the United States, the winter inaccessibility of the regions, the severity of the climate, the uninhabited and trackless districts, or the adverse physical conditions. If plotted on a map of the

United States this system would reach from Wyoming to the Bahamas, off the coast of Florida. The cables would reach from Newfoundland to Ireland, and the land lines from Washington to Texas.

"Its totality also comprises elements not elsewhere combined in a single system—submarine, land and wireless methods, all worked as one component and harmonious system. The entire construction of 3,738 miles includes not only 2,127 miles of cable and 1,504 miles of land lines, but also a wireless system of 107 miles.

"The United States has brought southeastern Alaska, the Yukon Valley and the Bering Strait region into telegraphic communication with the rest of the civilized world. There yet lacks to complete the dream of a half century of telegraphically uniting America and Asia *via* Bering Strait a cable to the Asiatic shore and a Russian land line of about 1,500 miles to Nikolaevisk.

"The signal corps wireless station at Nome could communicate with a similar station on the Kamchatka coast, but the infertile and sparsely inhabited country, thence to the nearest Russian station of Nikolaevisk, renders such an enterprise unlikely.

"It is important to note that the completion of the Alaskan lines perfects the military intercommunicating system of the United States. The President or Secretary of War can now reach, over strictly American lines of telegraph and cable, every important military command from the icy waters of Bering Strait to the tropical seas of the Sulu archipelago, with the exception of the legation guard at Peking."

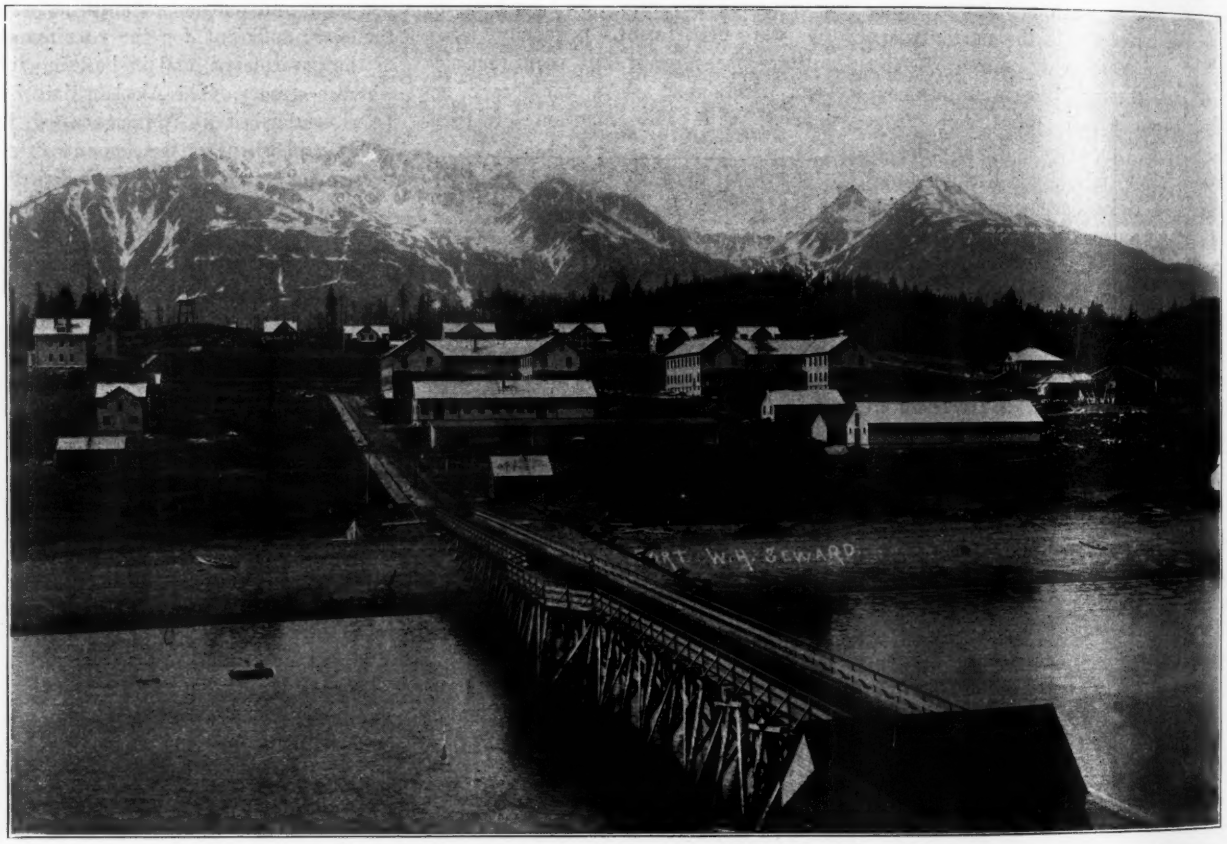
The offices on the Alaskan lines and the distances between them are as follows:

CABLES.

Seattle	0
Sitka	1070
Juneau	292
Fort William H. Seward	101
Skagway	20
Valdes	596

TELEGRAPH.

Fort Liscum	0
Lowe River	5
Valdes	3
Keystone	12
Saina	19
Teikhell	24
Tonsina	24
Copper Center	25
Christochina	66
Mentasta	46
Tanana Crossing	51
Ketchumstock	55
North Fork	30
Fort Egbert	68
Boundary	12
Summit	54
Central	58
Goodpaster	32
Salcha	60
Fairbanks	41
Chena	15
Nenana	47
Tolovana	55
Baker	37
Glen	18
Rampart	30
Cosna	35
Fort Gibbon	45
Birches	55
Kokrines	40
Melozi	38
Louden	35
Koyukuk	48
Nulato	32
Kaltag	40
Old Woman	45
Unalaklik	50
Golsovia	30
Saint Michael	35
Safety (wireless)	107
Fort Davis	20
Nome	4



ALASKAN TELEGRAPH. CABLE STATION AT FORT WILLIAM H. SEWARD.

Connections with outside commercial lines are made with the Western Union Telegraph Company and the Postal Telegraph-Cable Company at Seattle, with the Dominion government line at Fort Egbert, with the White Pass and Yukon line at Skagway and with the long-distance telephone line at Nome. Automatic repeaters are used in the offices at Ketchumstock and Fort Gibbon.

THE LAND LINES.

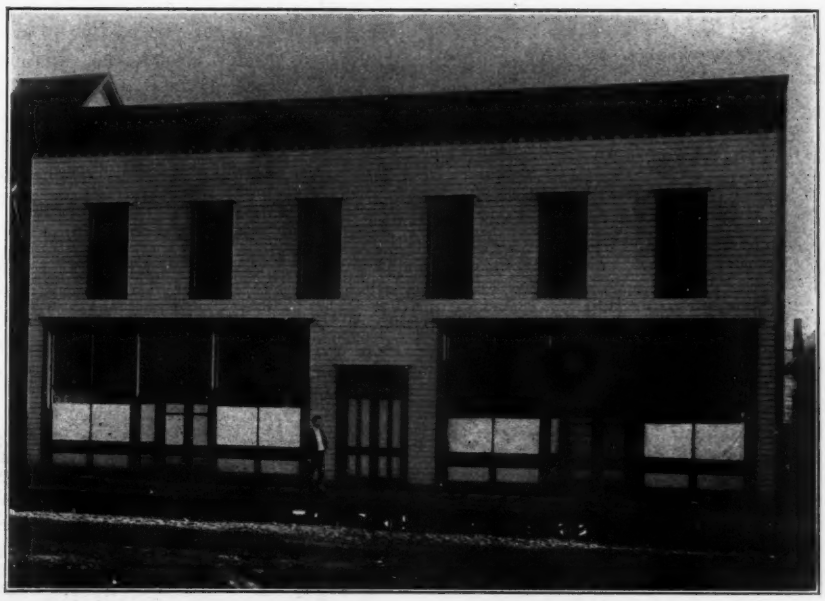
The land line consists of one No. 9 galvanized iron wire, carried principally on wooden poles of various sizes and lengths cut from the nearest forest. In some

places iron poles are used. Between Tolovana and Nenana, a distance of fifty-five miles, an insulated copper wire is laid on the ground or hung on branches of trees. Lack of funds prevented the building of a pole line on this section. The insulated wire is frequently broken by moose which become entangled in it. Along extensive stretches of the line routes from ten to forty feet wide were cut through dense forests. In such localities the wires are often interrupted by falling branches, while forest fires and snow slides are sources of much trouble, and the line is kept in operation with great difficulty.

On this subject the chief signal officer says: "The maintenance of these lines necessarily devolves heavy burdens on both the signal corps and the garrisons in Alaska. The original plan provides three men for each station, two from the

ALASKAN TELEGRAPH. ONE OF THE OPERATORS.

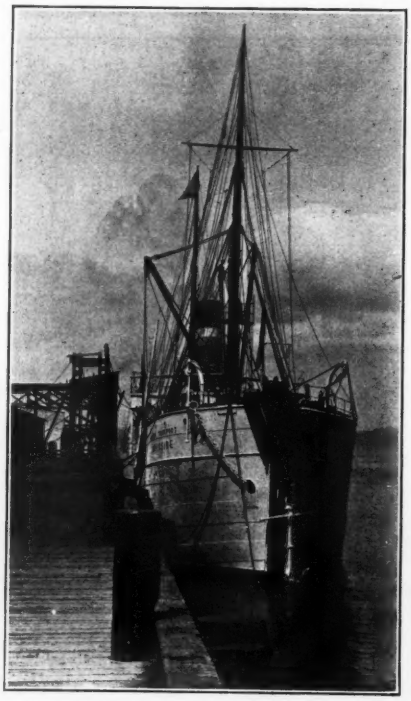
line of the army and one from the signal corps. As the telegraph system has been extended the number of enlisted signalmen has been largely increased. Repairs are maintained by parties stationed at log cabins about forty miles apart. Here are located one signal corps repairman with two assistants from the line of the army, it being too dangerous for a single man to travel alone in stormy weather, even with the dog team which is provided. Each repair detachment is provided with food for a year. Whenever an interruption of the line takes place the assistants proceed to locate and repair it. The life of these men, thus isolated from the world, is trying in the extreme, and the dangers of the repair trips, even in good weather, are very great. This is emphasized by the fact that during the past year three signal corps men died while actively engaged on repair duty, two by drowning and one from sickness; a fourth man suicided. In short, the difficulties of the situation can only be appreciated by those having had extended personal experiences in the interior of northern Alaska, where the conditions are enormously more difficult than along the usual lines of travel. It is not perhaps realized that every telegraph station is necessarily furnished with food and other supplies for at least a year in advance, as otherwise the men would be liable to perish of starvation. The necessary material and supplies, including dog food for repair teams for telegraph stations, are regularly transported by sleds in midwinter and in emergencies by pack animals in summer, save for stations situated on the Tanana and Yukon, which are supplied by boat in summer. The sledding work, of great magnitude and difficulty, is marked by hardships and suffering. It involved, during the past winter, the sledding into



ALASKAN TELEGRAPH. UNITED STATES MILITARY CABLE OFFICE AT SITKA, ALASKA.

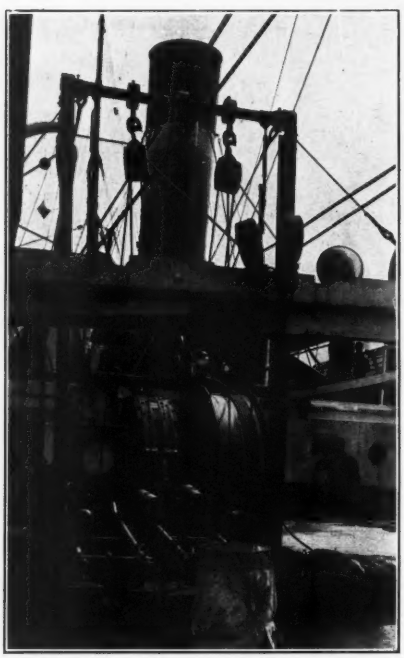
ALASKAN TELEGRAPH. INTERIOR OF THE CABLE OFFICE AT JUNEAU, ALASKA.

roadless regions of the interior about 270 tons of freight, including rations, forage, dog food, etc. The work usually begins in November and is finished near the end



GOVERNMENT CABLESHIP BURNSIDE AT TACOMA, WASH.

of March. Field service is very arduous and trying, as temperatures as low as sixty degrees below zero have been ex-



THE PAYING-OUT MACHINERY ON THE CABLESHIP BURNSIDE.

perienced in the interior. Blizzards occur occasionally and near the coast winter snowfalls are very heavy, some years exceeding sixty feet."

THE OPERATORS.

The government has two methods of securing men to operate its telegraph lines. The first is to make telegraph operators out of soldiers, the second is to make soldiers out of telegraph operators. In the signal service the men are graded as master electricians, first-class sergeants, sergeants, corporals, first-class privates and privates. The highest salary paid is seventy-five dollars per month, with allowances for clothing, rations and quarters and a chance of retirement on small pay after certain terms of service. If any of this journal's telegraphic subscribers desire to escape the temptations of Manhattan and are longing for the seclusion of an Alaskan office, they should prepare themselves to act as expert woodsmen, boatmen, hunters, pole climbers, housekeepers, cooks, laundrymen and, above all, to take care of, harness and drive the dogs. The offices and living rooms are usually in poorly built log houses which the operators must keep chinked up or freeze. For personal comfort and convenience the cable station on Midway Island, compared with the Alaskan huts, is a paradise. There is, however, one fact in favor of the Alaska men—the rapid development of that part of the country will soon bring civilization to them, while Midway starts at its best and must forever remain in a condition of hopeless solitude.

The route from Vancouver to the Copper river selected for the Collins line was entirely on land, while the signal officers cover this distance, about 1,600 miles, with the two cables laid along the coast. A considerable portion of the intervening territory has been supplied with telegraphic facilities by commercial companies.

THE CABLES.

The accomplishment of the signal corps in deep-sea cable laying was a splendid piece of work and marks the beginning of a new epoch in a great industry. Samuel Bishop went to his grave regretting that he had never been given an opportunity to make a cable to cross the Atlantic ocean. If the opportunity had come to him the cable would have been produced. Since his day other American manufacturers have been waiting their time and getting ready for the work. There is no good reason why the United States should not build, equip and profitably operate as good a cableship as there is in the world. General Greely has blazed a way for enterprising men to follow. His account of the Alaskan work is as follows:

THE ALASKAN TELEGRAPH. BURNSIDE'S MEN SHIPPING A CABLE BUOY.

"The Alaskan cable system involved not alone the telegraphic unity of American territory on this continent, but also American ability and resourcefulness in a new field. The construction, installation and operation of long submarine cables had previously depended on foreign skill and capital. Approved methods looked to gutta-percha cables, foreign-trained operators and British cable machinery, the evolution of forty years' successful work. After thorough investigation of the subject the chief signal officer of the army decided to install a seamless rubber cable of American manufacture to be operated by American soldiers, and to be laid by an American

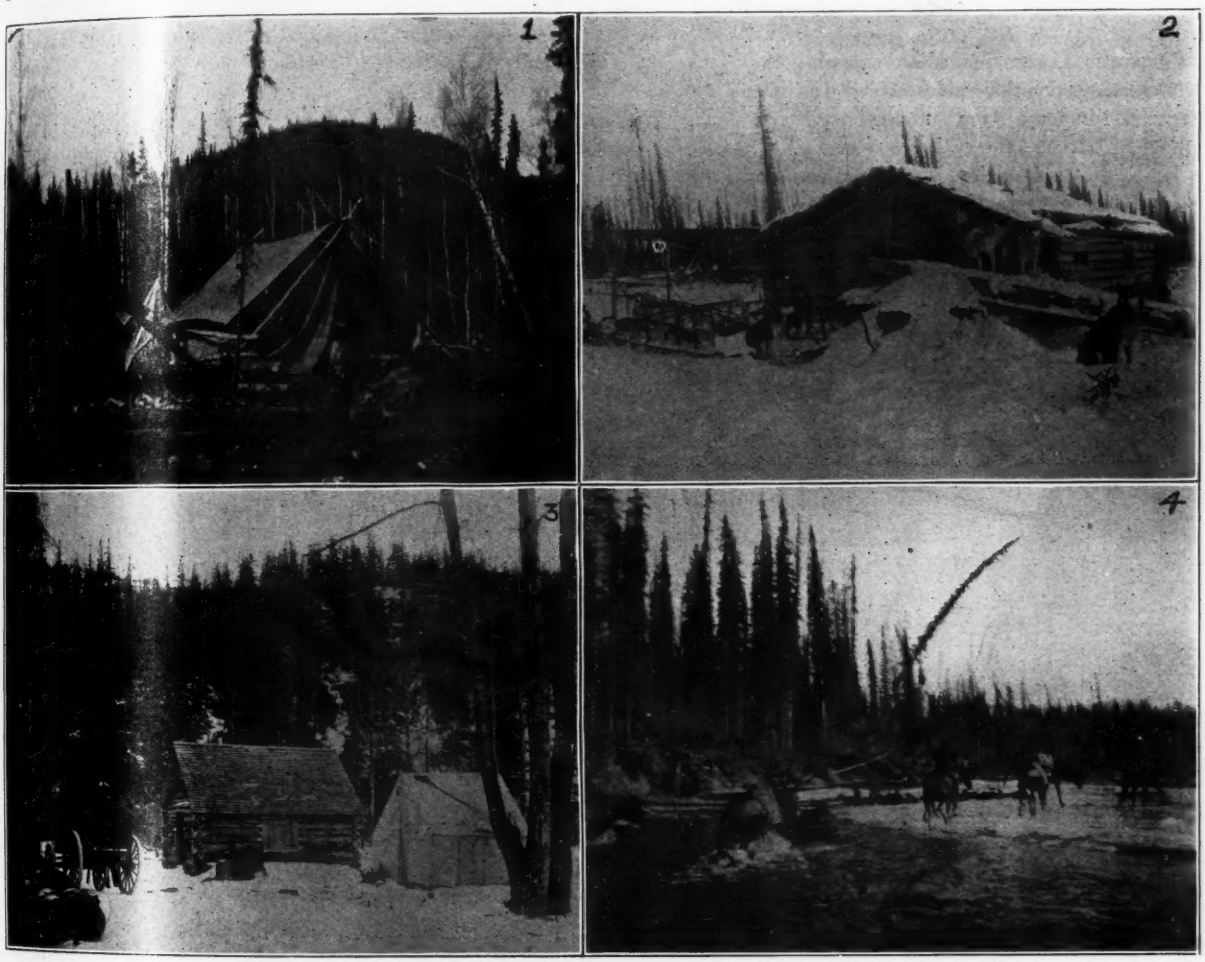
ship. For several reasons it was inadvisable to replace by American skill the cable instruments and machinery, brought to such a high degree of perfection by British skill. It may be here remarked that the radical departure as to American cables appears to be entirely justified. The seamless rubber cable between Sitka and Seattle, 1,070 miles in length and laid at an average depth of 1,000 fathoms and an extreme depth of 1,700 fathoms, in addition to being less expensive in its original cost, has a transmitting power greater by twenty-five per cent than was mathematically calculated on the basis of transatlantic gutta-percha cables. It is of military importance that in this connection a selected force of its men has been so trained in splicing, testing and operating, that to-day the signal corps of the army is competent to operate in war emergency a submarine cable of any length.

"Prompt action was taken with the Alaskan cablework as soon as the first appropriation was made in 1903. The conditions of the work were difficult. The cableship Burnside was in China undergoing repairs. The cable had to be manufactured in New Jersey and transported around Cape Horn, a journey of about 12,000 miles. As to the Alaskan water, the sea bottom was practically unsurveyed, while by shortness of days and by stormy months cablework is practically limited in these waters to five months, from May to September.

"The contract for the construction of the cable was awarded for both sections to the lowest bidder under public proposals, the Safety Insulated Wire and Cable Company, of New York. The specifications were of a high character, as regards both electrical and mechanical tests. The steel armor had to be specially manufactured, as a tensile strength varying from 90,000 to 120,000 pounds per square inch was insisted upon.

"Through the courtesy of Mr. George G. Ward, of the Commercial Cable Company, the services of Mr. A. B. Macmillan were obtained for the instruction of selected enlisted men of the signal corps as cable operators. The ability of the instructor and the aptitude of the men were such that within four months operators were so trained as to be theoretically and practically competent for cablework with the latest siphon instruments.

"Such energy and ability were employed by all cooperating parties that the first section of the cable, 291 miles, from Juneau to Sitka, was completed on October 2, 1903, and the nearest port of the American continent to the Asiatic coast brought into telegraphic communication with the world. Delay in commercial transportation around Cape Horn made the completion of the Sitka-Seattle section impossible in 1903, although 140 miles of cable were laid southward from Sitka, the end buoyed in 600 fathoms and the remainder of the cable stored at Tacoma. Exigencies that winter called the Burnside to the Philippines for repairs of old cables and the laying of new. Owing to delays in the Philippines it was not until June that the Burnside was able to resume work and leave Seattle for Alaskan operations. The cable buoyed having been carried away by winter storms, it



THE ALASKAN TELEGRAPH. 1—THE FIRST SUMMER CAMP AT CENTRAL. 2—INDIAN CABIN AND OPERATORS' OUTFIT AT THE MOUTH OF THE GOODPASTER. 3—STOREHOUSE AT KEYSTONE. 4—CONSTRUCTION PARTY CROSSING THE GOODPASTER.

became necessary to recover nearly all the cable laid and practically begin the work anew at Sitka. The present summer in Alaska has been exceedingly unfavorable; a series of gales and bad weather delayed operations and frequently endangered the cable. However, unremitting and persistent efforts on the part of Colonel Allen and his assistants completed this section on August 28, 1904. The Sitka-Seattle cable, 1,070 miles long, was at once thrown open to public use and has since been operated most successfully, its electrical conditions exceeding anticipations.

"Preparations were immediately made for installing the Sitka-Valdes cable. In order to increase the number of thoroughly trained officers in cablework, the laying of this section of 650 miles was entrusted entirely to the control of Major Edgar Russel, Colonel Allen having reported that his thorough knowledge of technical problems connected with cablework was conjoined to unusual efficiency in practical work, as shown in the performance of his duties as executive officer in the installation of the Sitka-Seattle section.

"Novel conditions obtained as regards cable transportation for the Sitka-Valdes section. As previously stated, delays in ocean transportation around Cape Horn prevented the installation of the Seattle-Sitka section in 1903. To obviate a recurrence of delays the risk was taken of transporting the entire amount of cable, 750 miles, purchased under this contract, by rail across the continent, which was successfully done in a remarkably short time by the Delaware, Lackawanna & Western and Northern Pacific Railway. The cable was delivered in good condition, and, as far as could be determined, suffered no injury or deterioration from rail transportation.

"Major Russel sailed from Seattle September 18, the Burnside being crowded with cable to its utmost capacity, both cable tanks and holds, the amount being far in excess of an ordinary cargo. Such action was necessitated by the lateness of the season, as her return for a second lot was impracticable without throwing over the completion of the section until the summer of 1905. The Burnside having laid the Fort Liscum-Valdes cable, left Valdes for Sitka on September 29, and buoyed the cable October 3, at Sitka. Later the shore end was landed at Sitka, and the cable system of Alaska entirely completed. The celerity with which the Valdes-Sitka cable of over 500 miles in length was put under contract, manufactured, transported and laid, illustrates American possibilities. Congress appropriated the money April 24, the contract was awarded, the cable manufactured in New Jersey, transported 4,800 miles by rail and sea, installed between Valdes and Sitka, and thrown open to commercial business in five months and twelve days."

ALASKAN TELEGRAPH. 5—LAYING CABLE FROM SHIP TO SHORE AT VALDES, ALASKA, SEPTEMBER 26, 1904.
6—A DOG-TEAM CONSTRUCTION TRAIN.

CHARACTERISTICS OF THE CABLES.

In the manufacture of the cables some radical departures from old methods were made. Foreign authorities on cable making and laying said they would not work, but experience has demonstrated that they will work, even better than was expected, and this incident suggests a caution to dogmatic philosophers not to be too confident in their conclusions. In 1858 an English scientist put on record the opinion that "electricity at a moderate immersion, subjected to a moderate superincumbent weight, is an effectual messenger, swift as thought; but when overweighted by immersion to depths where the superincumbent pressure amounts to thousands of pounds upon the square inch, then the messenger becomes paralyzed, and refuses to obey man's will; showing very clearly that until that pressure be artificially removed by insulating the conductor in tubes equal to restrain or keep from it that enormous load, the lasting success of an Atlantic telegraph is very doubtful."

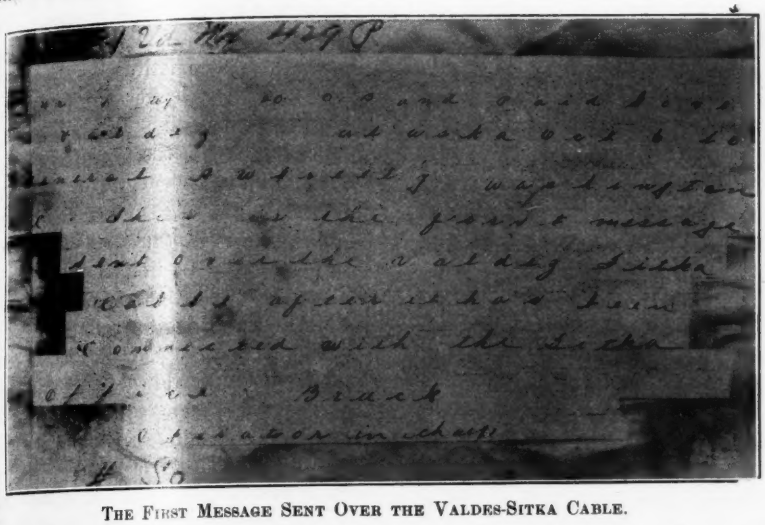
The specifications prepared by the signal officers and accepted by the Safety Insulated Wire and Cable Company contained most exacting conditions regarding materials, workmanship and quality of the product. The cables, during processes of manufacture and after completion, were subjected to the severest tests and proved satisfactory. The general plan followed in their manufacture is shown by the following description of the deep-sea type:

Conductors: seven No. 21 B. & S. best soft Lake copper wires, conductivity not less than ninety-eight per cent pure copper.

Insulation and armor: one layer of pure Para rubber one-sixty-fourth inch; layer of insulating compound containing not less than forty per cent of pure Para rubber, nine-thirty-seconds inch; layer of cloth tape saturated with rubber compound put on with double lap; serving of jute yarn steeped in clutch; sixteen No. 9 B. & S. galvanized steel armor wires with a lay of nine to ten inches. The completed cable was run through a hot asphalt compound, served with Calcutta jute; run through hot asphalt again, served with Calcutta jute in re-

verse direction to the first; again treated with asphalt and, finally, run through lime or soapstone to prevent sticking.

The successful results of this careful work were decisive and gratifying as



THE FIRST MESSAGE SENT OVER THE VALDES-SITKA CABLE.

shown by the constants of the Seattle-Sitka section.

Length, 1,060 miles.

Diameter deep-sea cable, eight-tenths inch.

Diameter intermediate, one inch.

Diameter shore end, one and one-half inches.

Weight deep sea, per mile, 3,000 pounds.

Weight intermediate, per mile, 6,000 pounds.

Weight shore end, per mile, 18,000 pounds.

Resistance copper conductor, per mile, 7.4 ohms.

Insulation resistance, per mile, 3,000 megohms.

Capacity, per mile, one-half microfarad.

Ratio of copper resistance to insulation resistance 1 to 440, or less than one-quarter of one per cent.

Speed with which cable may be operated, about thirty words per minute.

Greatest depth of water, 1,630 fathoms; average depth, about 1,000 fathoms.

THE WIRELESS TELEGRAPH SECTION.

One of the stations is located on the south side of Norton sound, at St. Michael, the other on the north side of the sound, at Safety Harbor, 107 miles apart. The latter is within twenty miles of Fort Davis and twenty-four miles from Nome. It lies just below the Arctic circle, on a line with the Klondike gold fields, Great Bear lake, Iceland, Archangel and Okotsk. Its degree of longitude sets it off in the Pacific ocean half-way between the Hawaiian Islands and Samoa.

At each of these stations there have been erected two masts, 210 feet high, between which are suspended fan-shaped antennæ, consisting of 125 copper wires one foot apart, and buildings especially adapted to the needs of the offices. The motor power consists of a five-horse-power gasoline engine and a three-kilowatt motor dynamo, sixty-cycle alternator. One station has a transformer "stepping up" from 500 to 20,000 volts, the other a transformer "stepping-up" from 500 to 25,000 volts. The transmitting and receiving apparatus embraces some of the De Forest devices together with various appliances invented by Captain Wildman and other signal officers. The equipment for these stations was landed from the vessel in which it was transported on August 4; two days later messages were exchanged and on

STATION AT LOWE RIVER, ALASKA.

August 17 that section of the Alaskan telegraph system was thrown open for public business. The operating capacity of the wireless stations is limited, practically, by the skill of the operators, and business is ordinarily transmitted at the rate of twenty to thirty-five words per minute. In one afternoon 5,000 words were exchanged between the two stations. To-day (November 5) General Greely received word from his superintendent at St. Michael that, since the wireless service was inaugurated, there has not been an hour's interruption in its operation. Norton sound is generally frozen up for eight months of the year, and without the means of communication thus afforded by the government's telegraph system, that region would be isolated from the rest of the world. While these stations were established especially for communication with each other, it is believed that they will be able to send and receive messages over any distance up to 500 miles. This possibility opens a vast field for their future usefulness in communicating with points on the coast of Asia and with vessels out at sea. Beyond these electrical outposts, the territory of the United States embraced in the islands of the Aleutian group leads out a thousand miles further westward, to the longitude of New Zealand, and affords many good positions for wireless or cable telegraph stations.

GOVERNMENT BUSINESS OF THE LINES.

This is not confined to communications relating to military matters, but every other department of the government makes extensive use of the facilities provided. Various bureaus of the treasury department, the department of the interior, the post office department, the department of commerce and labor and other branches of the government are sending a large amount of business over the lines.

PRIVATE BUSINESS OF THE LINES.

Immediately upon the opening of a section of the line private business was offered and accepted and this has constantly and rapidly increased. The commercial business of one month recently closed up amounted to over $10,000 and the prospects are that the receipts of the next year will exceed $100,000. The tariffs on commercial messages are: from Seattle to Sitka, $1.50; to Skagway, $2; to Valdez, $2.50; to Fort Egbert, $3; to St. Michael, $3.50; to Nome, $4.

In bringing this great undertaking to such successful and valuable results many efficient and faithful officers and men have been engaged, harmoniously and unitedly working together under the able administration and with the vigorous support of General Greely, and to every one of them credit is due.

The chief signal officer especially commends the intelligent, energetic and skilful services of Colonel James Allen and Major Edgar Russel in the installation of cables, and of Captains George C. Burnell, George S. Gibbs and William Mitchell and Lieutenant O. B. Grimm in building land lines, and Captain Leonard D. Wildman in establishing the wireless system. All of these officers have had long service in the signal corps and are exceedingly efficient in the various branches of telegraph engineering.

THE ALTERNATING-CURRENT RAILWAY MOTOR.

PAPER AND DISCUSSION BEFORE THE NEW YORK ELECTRICAL SOCIETY.

The two hundred and forty-fifth meeting of the New York Electrical Society was held at 19 West Forty-fourth street, New York city, on Wednesday evening, October 26. Frank J. Sprague called the meeting to order and spoke, in part, as follows:

The potential at which motors are operated has been, by common consent, limited on account of motor commutation to about 600-650 volts, an increase of only 150 to 200 volts in the past fifteen years. There now seems to have grown up the conviction that this is the limit to continuous current potentials for practical railway purposes. To that I must take exception. But, be that as it may, it is perfectly clear that if electric railroads are going to extend beyond the tramway, beyond the underground, the elevated, and the single-car suburban service, the question of investment in conductors and in apparatus energy must be very seriously considered.

What is desirable, and what is sought in the development of the single-phase commutator motor, is to get rid in the first place of one of the elements in the substation, the rotary or movable one, leaving the step-down transformers as the permanent equipment. The other is to raise the potential on the trolley line, considerably above that which has ordinarily been used on continuous current operation, and therefore increase the distance between substations. I think that possibly the hopes in this respect are somewhat exaggerated, and for these reasons:

When taking up the heavier problems of railway transportation, it is with the necessity of plurality of motor equipments, no matter whether we deal with locomotives or with cars distributed throughout a train, and if a plurality of motors be used, then, adhering to our present practice of series parallel operation, it is possible to raise the working potential to say 1,300 volts.

If we compare continuous and alternating current layouts, then, considering maximum potentials, and bearing in mind that the effective working potential of the alternating current is considerably less than the maximum, and further that the iron rails offer much less facility for conducting alternating currents than continuous ones, we will find that if we have a given distance between substations or a continuous current layout of, say 1,300 or 1,400 volts, to go double that distance on an alternating current layout, the maximum potential would have to be raised to not less than 3,000 or probably 3,500 volts.

President Sprague introduced Professor A. S. McAllister, who lectured upon the "Alternating-Current Railway Motor."

In his opening remarks, Professor McAllister showed that if in an alternating field there be placed an armature connected to a commutator by methods common in direct-current practice, it will be found that with the armature stationary there will be generated in the conductors an electromotive force on account of the rate of change of flux through the armature coils as in a stationary transformer, and that the maximum measurable value of such electromotive force, as it appears at the commutator, will exist between points placed in mechanical line with the field flux and spaced 180 electrical degrees apart. When the armature is in motion, neither the effective value nor the time-phase position of this transformer electromotive force is altered, except in so far as other disturbing influences may be brought into play, but, due to the dynamo speed effect, there is generated in the armature coils an electromotive force which appears externally as a maximum at points on the commutator ninety mechanical degrees from the field flux, as is true with direct-current generators. This latter electromotive force is proportional to the product of the speed and the field flux, and hence is in time-phase with the alternating field. Experiment verifies the theoretical determination that at synchronous speed the effective values of the dynamo electromotive force and of the transformer electromotive force are equal, and due to the fact that they are in electrical time-quadrature and mechanically displaced ninety degrees. An electromotive force of equal value will be found to exist between any two points on the commutator situated 180 electrical degrees apart. From these facts it follows that when such an armature is revolving at synchronous speed in an alternating field of any strength, the effective value of the electromotive force at the commutator must be the same in all diametrical positions.

Consider now the circuits of a plain series motor, having equal number of effective turns on the armature and on the field coils, and assume that the magnetic reluctance is the same in all directions around the armature core. Under all conditions of operation, the field coils act as an impedance in an alternating current circuit, while, when the armature is stationary, its coils form a similar and equal impedance. Neglecting hysteretic effects, the armature current and the field magnetism are in time-phase and in mechanical position to give to the motor a torque which retains its direction with the reversal of flux and current. When the armature is in motion, there will be generated an electromotive force, which appears at the brushes, and which is in time-phase with the field flux, or phase-opposition to the armature current. At synchronous speed this in-phase component of electromotive force is just equal to the reactive electromotive force of the armature or of the field coil, so that, neglecting losses, the power-factor would equal the cosine of that angle whose tangent is two, or the power-factor is .446 and the apparent impedance has increased to $\sqrt{1 + .25} = 1.1$ of its stationary value. Thus at synchronous speed the torque, which varies as the square of the current, would be reduced only to 66.6 per cent of its stationary value. If the frequency be lowered, the speed corresponding to synchronism will be correspondingly altered, but the above relations will yet hold true at this speed. It is, therefore, apparent that the unity-ratio, single-phase, plain-series motor with uniform reluctance around the air-gap is unsuited for traction.

It may be shown that a change in the ratio of field to armature turns only slightly affects the relation given above, unless such change be accompanied with an increase in reluctance of the magnetic structure in line with the brushes. By using projecting field poles, thus leaving large air gaps in the axial brush line, the local inductive reactance of the armature may be materially reduced, even when an increased number of armature conductors is employed, so that at synchronism the armature speed electromotive force may be made large in comparison to the reactive electromotive force of the armature and field circuits, and the power-factor will be thereby correspondingly increased with a resultant improvement in the torque characteristics of the machine. Even under the most favorable conditions, it is impossible to reduce the reactance of the armature circuit to an inappreciable value, due to the inevitable presence of the magnetic material of the projecting poles.

The most satisfactory method of reducing the inductive effect of the armature current is to surround the revolving armature winding with properly disposed stationary conductors through which flows current equal in magneto-motive force and opposite in phase to the current in the armature. This compensating current may be produced inductively by using the stationary winding as the short-circuited secondary of a transformer of which the armature is the primary, or the main line

current may be sent directly through the compensating coil. In the former case, the transformer action is such that the compensation is practically complete, giving minimum combined reactance of the two circuits, while in the latter case, the compensation can be varied at will. It is found that in any case the best general effects are produced when the compensation is complete, and experiments seem to indicate that under such conditions the induced and the forced methods of compensation differ inappreciably for strictly alternating-current operation, but that for direct-current work, where the forced compensation can be used to prevent field distortion and improve the commutation, the latter method is preferable.

Excellent performance of the compensated alternating-current motor may be obtained by using the field coil as the load circuit from the compensating coil employed as the secondary of a transformer, the armature being used as the primary. Under the conditions here assumed, the current in the primary (armature) is in phase opposition to that in the secondary (compensating and field coils), while the field flux is more or less accurately in phase with the secondary current. Since the field flux and the armature current reverse together, the fluctuating torque remains in one direction.

The speed electromotive force is in phase with the field flux, or approximately in phase (opposition) to the armature current. At synchronous speed neglecting losses, the tangent of the angle of lag is equal to the ratio of turns in the field coil to those in the compensating coil, and decreases directly with increase of speed, so that the power-factor, the corresponding cosine, can be made quite large for synchronous speed while it continually approaches unity as the speed increases. These statements which easily admit of theoretical demonstration are substantially corroborated by experimental observation.

Tests show that the effect of the short-circuit by the brush of a coil in which is generated an active electromotive force which would tend to decrease the power-factor, is counterbalanced by the fact that the field flux lags somewhat behind the secondary current, and the real speed electromotive force, therefore, lags behind the primary current, tending to cause the current to become leading and to increase the power-factor. The field flux continually decreases with increase of speed, so that in any case the short-circuiting effect is relatively small.

A slight modification of circuits of the above-described induction series motor, such that the primary and secondary circuits are interchanged, leads to the Atkinson type of repulsion motor. Under starting conditions and up to a speed slightly above synchronism the performance of each machine is quite similar to that of the other. Beyond synchronism, however, the repulsion motor is in all respects inferior to the induction series machine, due to the fact that with the former motor the short-circuiting effect increases with an augmented rate as the speed increases, though of zero value at synchronism, and becomes prohibitive when speed is much in excess of this value. It may be shown that the facts do not justify the claims for high power-factor of the primary current due to condenser effects in the secondary low iron loss in any magnetic circuit, except the armature at synchronism, and superior commutation of this machine, except near synchronism, and that the operation of the repulsion motor is limited to the range between zero speed and synchronism.

A type of alternating-current commutator motor suitable for railway service, which, as a subject for theoretical investigation, is of all machines the most interesting, is found in the repulsion series motor. The circuits of this machine are similar in most respects to those of the plain series motor with uniform reluctance around the magnetic circuit, but it possesses an additional set of brushes shorted upon themselves in mechanical line with the windings on the stator. In distinction to the performance of the compensated series motor, in which the effect of speed is to increase the apparent resistance of the armature which possesses negligible reactance, the armature of the repulsion series motor possesses at starting the major portion of the apparent reactance of the motor circuits and the effect of speed is to decrease such apparent reactance continually with increase of speed according to a parabolic law, the reactance becoming zero at either positive or negative synchronism, and negative at higher speeds in either direction. While with the series motor, the field circuit constitutes at all times the major portion of the reactance of the machine, with the repulsion series motor the field circuit is practically non-inductive at starting and the effect of speed is to introduce in the coil an apparent resistance which increases directly with the speed, and becomes negative when the speed is reversed.

This behavior on the part of the circuits of the machine is due to the fact that under speed conditions the armature conductors cut the flux produced by the current which flows through the armature coils, the electromotive force thus generated in the armature at the short-circuited brushes being counterbalanced by an electromotive force, due to the rate of change of flux introduced into the armature core by current in this local circuit, such flux generating in the field coils an electromotive force in time-quadrature with itself and hence in phase (opposition) with the circuit current, giving the effect of resistance, and causing the generation at the main brushes of an electromotive force in time-phase with itself and hence in quadrature with the circuit current giving the effect of negative reactance. Experiments fully confirm these theoretical deductions. A disturbing influence is found in the fact that the armature is never strictly without apparent resistance, nor the field coils entirely free from reactance, due primarily to the short-circuiting at the brushes which becomes quite prominent and predominating above either positive or negative synchronism.

If a resistance be placed in shunt circuit to the field coils of a direct-current series motor, the armature is in general subjected to an increased torque and the result is an increase in speed If a similar resistance be placed across the field coils of an alternating-current series motor, the result is entirely different, since the current, which flows through the resistance, is out of phase and leading with respect to the field flux. Under speed conditions, the current taken by the resistance traverses the armature circuit quite independently of the current which reaches the field coil, the effect being that the resultant line current leads the impressed electromotive force so that the resistance acts quite similarly to condensance to cause the power-factor to become unity, and then to decrease with leading wattless current. It can be shown that the energy thus absorbed is that incidental to the use of the resistance and that for a given current it is unaffected by the speed electromotive force. Thus the current taken by the resistance multiplies into the stationary transformer electromotive force to give the actual watts absorbed, while the same current multiplies into the speed electromotive force to give apparent leading wattless power.

Opening the discussion, President Sprague said that it is clear that what is generally sought in the development of the single-phase alternating-current motor is to run a series motor on an alternating current, and retain, as far as possible, its excellent character, but that this effort is handicapped by the transformer action which takes place.

Mr. A. H. Armstrong, Schenectady, N. Y., said that as far back as 1893 the General Electric Company had commenced to experiment with different

forms of induction motors and tried to apply them to railway work. He thought that it took some twelve months to put them through the factory, finally mounting them on a car with an indifferent type of controller. From this time to the present the company has been experimenting with some form of alternating-current motor for railway service. Two or three years ago a single-phase motor of the commutator type was resurrected. Different experiments had been worked out quite satisfactorily on this form of motor with different frequencies. About two years ago these experiments were renewed with 200 cycles. Mr. Armstrong called attention to the necessity of electric cars for suburban service being so equipped that use could be made of both alternating-current and direct-current systems. He then called attention to the modifications of the alternating-current motor that had led up to the present type of compensated series motor which has been developed for suburban work to meet the demands imposed by an alternating-current system. This motor, he stated, would run outside of the city as an alternating-current motor, and within the city limits as a direct-current machine.

Mr. C. F. Scott gave some personal reminiscences of early work with alternating-current motors as applied to traction, describing the motors and the results which were disappointing.

Concerning the commercial status of the single-phase motor at the present time, he said that the Westinghouse Electric and Manufacturing Company has now under consideration in its factory orders for different roads for a total of 186 single-phase railway motors of varying size, having a total capacity of 11,400 horse-power. The sizes range from fifty to 150 horse-power. The equipments are along the line of the direct-current equipments, both double and multiple unit.

The maximum speed on all of the roads which are now being equipped is sixty miles per hour, the interurban trolley voltages range from 1,100 to 3,300, and for city work from 400 to 700, and the cars range from twenty-five to fifty tons, including electrical equipment. The various roads give a total of about 200 miles. The longest of these roads is from Indianapolis to Cincinnati, fifty-seven miles, which will probably be extended afterwards to about double that distance. The motors are rated at 300 horse-power. There will be no difficulty in building motors to 400 horse-power for railway service and using even higher voltage up to 3,000. These orders show the real hold that the single-phase motor is taking in railway work. The roads are practically all suburban or interurban roads. The one from Cincinnati to Indianapolis will be started within a few months. The details of line construction for higher voltage require different designs and construction all through. But the motor itself does not in a general way materially differ after all from the direct-current motor. But the great thing which it does is to change the system throughout. It is revolutionary in character. The problem heretofore has been to put the stations as far apart as possible. If no men are required at substations, the problem becomes very different, and it may be practical to keep the stations the same distance apart and in some cases placing them even closer together. The whole conditions of solving the general problems of a railway system are modified by the alternating-current motor.

Mr. Henry A. Lardner said the first thing that impresses one when riding in a single-phase car is the apparent perfection of the alternating-current motor. In fact, it seems to be an almost perfect motor; but its effect on the system, its use in connection with the rest of the apparatus is one involving questions of very great importance. Naturally, we do not want to adopt the alternating-current motor unless we can make some saving in first cost, or some saving in cost of operation. The principal saving in operation would appear to be in cost of attendance at the substations. He believes that in a great many cases it will be necessary to retain this attendant and charge his time to something else if the single-phase motors were adopted and the rotaries eliminated. The operating expenses would not be decreased, but the distribution would be changed. He looks for a considerable saving in first cost in many cases. The increased resistance of the rail to the alternating current, and the increased impedence of the circuit tend to counterbalance the saving due to increased pressure to a surprisingly large extent. Whether or not a saving in first cost can be realized will depend very largely on the particular problem in hand.

Mr. C. O. Mailloux called attention to the different lines along which development of single-phase traction motors is being carried in this country and in Europe. Here a motor resembling, as closely as possible, a direct-current series motor is accepted as the best type. Abroad, while the Latour motor closely resembles the compensated series motor, the results are obtained in a different way in the Winter-Eichberg motor. In this motor the stator is connected in shunt across the supply circuit, the rotor is short-circuited through brushes, and an exciting current is supplied to the rotor through other brushes placed midway between short-circuiting brushes. The motor is controlled by varying the exciting current. The Winter-Eichberg motor has been in use for some time on the Spindlersfeld-Nieder-Schoenweide line, a short road near Berlin. This motor has been described previously. The points of general interest are the potential of the supply, which is 6,000 volts; the use of the multiple unit control, and the suspension of the working conductor, a so-called "catenary" construction being used. It is claimed by Dr. Eichberg that with the use of this system the energy consumption is somewhat lower than it would be were direct current used.

Mr. Mailloux had made particular inquiries about the operation of the commutators and contactors. The latter have been in use continuously since the road started in June, 1903, without receiving any attention. It is found necessary to sand-paper the commutators after a run of from five to seven weeks. The Winter-Eichberg motor is used also on the Stubaithal lines in the Austrian Tyrol. The supply voltage in this case is 3,000. According to Dr. Eichberg, there is no objection to using any frequency with his motor. It operates just as well at a frequency of forty to fifty cycles as with one much lower.

Mr. Mailloux, on his recent trip abroad, visited also the Oerlikon works, and inspected the system worked out by Mr. E. Huber, chief engineer of this company. The system is intended to demonstrate the applicability of electric traction on steam roads. For this purpose a short part of the Swiss national railroad system, known as the Seebach-Wettling line, has been equipped. The locomotive tried first was constructed according to the Ward Leonard system, drawing its supply at 15,000 volts from the working conductor. This conductor is carried normally on the top of short poles beside the track, the contact arm pressing upon it. The arrangement, however, is such that the line may be carried directly over the car, contact in that case being made at the bottom. The Oerlikon Company is at the present time developing a locomotive equipment consisting of single-phase alternating-current motors designed for a frequency of fifteen cycles.

An interesting point in the equipment of this line is the adoption of visual signals to indicate defects in any insulator. It is said that the estimated cost of line equipment, including poles, contact wires, section switches and other accessories, is about $2,400 per mile, and the estimated drop at the distant end will not exceed three and one-third per cent.

Estimates of cost of equipment and operation of the St. Gothard tunnel line according to this system show that the saving in the cost of operation over steam would be equal to more than ten per cent of the total capital investment including the cost of electrification or fifteen per cent of the present capital investment if the cost of electrical equipment is not included.

Mr. Mailloux called attention to the alleged decrease in the useful track adhesion with the single-phase alternating-current motor operating at a low frequency which produces an alternating torque. It is said that the average drawbar pull with this equipment should only be about fifty per cent of that allowable for a direct-current motor. At high frequencies this effect is less pronounced, and it may even disappear.

The speaker closed with an expression of his confidence in the suitability of electric traction for heavy railway work, and his belief that progress in its development and extension will be much more rapid than most people now believe.

PURIFICATION OF WATER FOR THE PRODUCTION OF STEAM.[1]

BY J. O. HANDY.

In the United States we have all classes of boiler feed waters, from the nearly pure waters of New England, to the exceedingly hard or "foaming" waters of the Middle West which derive their boiler-incrusting constituents from the limestone, gypsum or other mineral deposits through which they pass.

Corrosive waters containing free sulphuric acid and acid iron salts occur in all coal-producing districts, especially in those places where coal is washed preparatory to coke production. The waters of the Youghiogheny and Monongahela rivers in Pennsylvania are contaminated in this way, causing great trouble and expense to steam users.

Mountain streams often contain so little scale-forming matter that the excessive amounts of dissolved oxygen or carbonic acid which they carry in solution may cause corrosion.

Peaty waters are found which contain corrosive vegetable acids. Such waters are most common through the southern states.

Well waters containing magnesium chloride are corrosive, unless they contain an excess of calcium carbonate.

The more or less complete removal of scale-forming matter or the neutralization of corrosive substances which occur in boiler feed water has been carried out by several methods in the United States.

The methods may be classified as follows:

I—MECHANICAL METHODS.

These include feed-water heaters, scum-catchers and blow-off cocks.

II—CHEMICAL METHODS.

(a.) Direct Method—The chemicals are placed in the boiler or run into it with the water supply.

(b.) Indirect Method—The chemicals are fed into the water on its way to a storage tank which serves also for the completion of chemical reaction and for sedimentation.

(c.) Intermittent Method—The chemical treatment is given alternately to the contents of two tanks, allowing reaction and sedimentation to take place during periods of quiet. Partially clarified water is drawn off through filters and repumped to storage tanks.

(d.) Continuous Method—The chemical treatment is given automatically to the water as it enters the apparatus. The chemical reaction, sedimentation and clarification take place simultaneously or successively during the progress of the water through the apparatus.

[1] Abstract of a paper read before the International Congress, St. Louis, October 3 to 8, 1904.

CLASS I—MECHANICAL METHODS.

Feed-water heaters remove more or less completely from water the carbonate of lime which it contains, but other and more important scale-forming substances are not affected and pass on into the boiler from which it is impossible to remove them except very imperfectly by scum-catchers or blow-off cocks.

It is doubtful whether removal of carbonate of lime from feed water by means of heaters ever pays. The heater becomes encrusted and continually more unfit for its principal work, which is the preheating of boiler feed water. When encrusted with scale it neither purifies nor heats satisfactorily.

Schemes for heating boiler feed water under pressure before passing to the boiler have never passed the experimental stage, owing chiefly to the imperfect precipitation of scale-forming substances by short exposure. Sulphate of lime deposits as scale in boilers very gradually with increasing concentration. Pressure and temperature have a modifying influence on the rate of deposition, but no temperature is reached in steam boiler practice at which sulphate of lime immediately falls out of solution.

CLASS II—CHEMICAL METHODS—
2 A—DIRECT METHOD.

This practice has been and is very general in the United States and the beneficial results obtained have been in exact relation to the judgment shown in selecting the chemicals and the care shown in carrying out the details of the treatment.

The purifying agents used directly in boilers include:

1. Soda ash.
2. Caustic soda.
3. Phosphate of soda (tri-sodium phosphate).
4. Tannin compounds.
5. Fluoride of soda.
6. Aluminate of soda.

Soda ash has been most widely employed. Used without discrimination, it is rarely beneficial.

The experience of the Chicago, Milwaukee & St. Paul Railway proved conclusively that the systematic use of soda ash, combined with regular blowing off of the sludge produced by chemical action, was a measure of great economic importance.

THE SODA-ASH SYSTEM.

Principle: "when waters are treated in the boiler with soda ash, the incrusting solids are changed to carbonates and precipitated as a soft sludge which is readily blown out, instead of coming down in a crystalline condition and adhering to the boiler."

AMOUNT OF SODA ASH USED.

For Each Grain per Gallon.	Soda Ash per 1,000 Gallons.
Calcium carbonate	0.02 lb.
Magnesium carbonate	0.02 "
Calcium sulphate	0.10 "
Magnesium sulphate	0.13 "
Magnesium chloride	0.16 "

Advantage of Direct Soda-Ash Treatment—Elimination of first cost and interest charges on softening machines or plants.

Limitations of Direct Soda-Ash Treatment—Boilers must be more frequently washed out, because blowing-off does not completely remove sludge. Foaming occurs frequently due partly to suspended sludge and partly to the pressure of carbonate of soda in variable excess in the water. Very hard water can not be treated sufficiently to prevent scale formation without introducing soda enough to cause foaming.

OTHER CHEMICALS.

Of chemicals other than soda ash, it is probable that phosphate of soda (tri-sodium phosphate) has been most largely used for the direct treatment of boiler feed waters.

Aside from its price, which is about four times that of soda ash, phosphate of soda has certain advantages. It produces by its action on the lime salts in the water, flocculent, amorphous precipitates which are absolutely non-adherent to boiler surfaces and are easily blown out.

Advantages of Tri-Sodium Phosphate—Convenience of application. No plant required except a gauged barrel attached to feed line. Focculent, non-adherent sludge instead of the more dense crystalline one produced by soda ash.

Limitations of Tri-Sodium Phosphate—The price, formerly six cents per pound and still about four cents, taken together with its high combining weight, makes it at least nine times as expensive as soda ash for water-softening purposes. It can not be used for complete softening of cold water because the chemical reactions are not finished in any reasonable time without heat. Magnesia precipitates very slowly indeed. Furthermore, the precipitate is bulky and an apparatus with unusual sludge room would be required.

Lime and Soda Ash—Lime or lime and

soda ash (equivalent to wholly or partially causticized sodium carbonate) have been fed directly to steam boilers in some cases.

In the treatment of acid waters from coal mines and washers, some large steam users have kept their boiler water supply neutral by means of milk of lime fed proportionately through feed pumps. Others have used soda ash alone. The best practice for acid waters, however, is the use of lime and soda ash in equivalent amounts.

The lime of treatment leaves sulphate of lime, a scale-forming substance, in the water. The soda-ash treatment leaves free carbonic acid in the water and the iron salts are incompletely removed in consequence. Foaming is also encouraged by the carbonic acid gas. No by-products of injurious nature are formed when dilute caustic soda, or lime + soda ash are used for acid waters.

Caustic Soda, Barium Hydrate, Etc.—In 1880, Dr. C. B. Dudley, chemist for the Pennsylvania Railroad Company, obtained a patent on a process using caustic soda for purifying water, claiming as a result that the lime and magnesia separate as carbonates and the iron and alumina probably as hydrated oxides.

In 1883, he obtained a patent for the use of soda lime for similar purposes. In 1884, he patented the use of barium hydroxide.

Sodium Fluoride—In 1890, Dr. Charles A. Doremus presented a paper before the American Chemical Society calling attention to the use of fluorides, particularly sodium fluoride for softening hard waters.

At that time the most important statement made was that the precipitation of magnesium "is especially thorough and noteworthy."

Dr. Doremus afterward suggested the use of caustic soda with sodium fluoride.

Griffin found the precipitating action of sodium fluoride on lime salts in water fairly complete and on magnesia salts very trifling. The writer found sodium fluoride an exceedingly unsatisfactory precipitant for any of the lime or magnesia salts occurring in natural waters. No important use of the fluoride method in water softening practice has come to the writer's attention. Dr. Doremus states that its high price prevents its more general use.

Sodium Aluminate—In January, 1889, Professor C. F. Mabery and Ed. Baltzley called attention to the use of sodium aluminate for removing lime and suspended matter from waters.

Griffin's experiments confirmed to some extent the efficiency of the reagent for precipating bicarbonates of lime and magnesia and magnesia salts. Sulphate of lime was not affected.

The reagent apparently acts like caustic soda with the assistance of the liberated alumina as a coagulent.

Of all the chemicals available for direct treatment of boiler feed water, sodium phosphate is best and soda ash and lime next. Any direct treatment should be regarded merely as a temporary expedient to be superseded by softening machines as soon as conditions permit.

2 B—INDIRECT METHOD.

Treatment of water by the introduction of chemicals into the water as it flows to the storage tank was the first step in the evolution from direct treatment toward complete softening machines. It was designed to avoid the first cost of softening machines by utilizing the existing storage tank for chemical reaction and sedimentation. Several such plants exist in the United States and many have existed. They have no feature to recommend them except low first cost. In their simplest, crudest form, they consist of:

1. An arrangement for supplying chemical solution at approximately the required rate from a barrel attached to the suction of the supply pump.

2. A floating draw-off in the service so that approximately clear water may be drawn from it.

3. A dump valve in the bottom of the service tank for sludge removal. As the tank bottoms are usually flat, only the sludge which lies close to the outlet will be discharged.

Having usually only an imperfect chemical proportioning device, no arrangement for ensuring steady progression of water through the storage tank, and no provision for drawing off more than part of the sludge without emptying the tank, such plants do only imperfect work.

2 C—INTERMITTENT METHOD.

Of the devices already described those operating under method "2 *a*" are "continuous," while those under "2 *b*" are more or less intermittent. In the former case the treated water goes continuously and immediately to the place of use and in the latter there is an interval of uncertain length between its treatment and use.

The devices under this heading are intermittent in operation in that there is a pause of several hours after treatment. This is to give the time considered necessary for chemical reaction and sedimentation.

In the commercial development of the intermittent system of water softening, N. O. Goldsmith, of Cincinnati, Ohio, and J. B. Greer, of Pittsburg, Pa., have done important work. Many of their plants have been installed in the United States and the systems are styled, respectively, the "We-Fu-Go" and the "Ideal." Their work dates principally from the year 1896.

They added to previous practice in the country the following points:

The use of milk of lime instead of lime water.

The use of sand filters to clarify the softened water.

The "We-Fu-Go" plants have paddle stirrers while the "Ideal" plants use compressed air for mixing and agitating purposes. There are no other essential differences.

The general plan of operation is as follows:

Two tanks are provided, the aggregate capacity of which is usually eight times the hourly output expected. These may be of either wood or iron construction and may be placed on ground level or elevated on trestle-work according to whether repumping or softened water is to be allowed for or avoided.

The tanks are filled alternately to a certain level with hard water. In some plants the milk of lime is added during the filling and the agitator is run at the same time. In most of the plants, the Archbutt-Deeley practice of dissolving the soda ash in the milk of lime and adding both together when the tank is filled, is the one followed.

Agitation continues for fifteen to twenty minutes followed by a period of perfect rest usually approximating four hours.

At the end of this time the softened water is drawn off from near the surface through floating discharge pipes. It passes through sand or crushed quartz filters to storage tanks from which it is repumped to a higher elevation if necessary.

THE DAVIDSON INTERMITTENT SOFTENER.

Mr. G. M. Davidson, of the Chicago & Northwestern Railway Company, has devised a water-softening plant whose chief features are the use of continuous chemical feed and the adaption of the supply pump for agitating purposes. Mr. Davidson adopts the tipping-bucket device, already known in the chemical industry and used by Bruun in a different manner for the feeding of the chemical solution to the flowing water.

The bucket as it oscillates under the

influence of the stream of hard water is made to operate:

(*a*) A stirrer in the chemical supply tank (not new).

(*b*) The plungers of two pumps which feed the required amount of chemical solution into the bucket compartments alternately.

The preliminary mixing of chemical solution and water is due to the stirring influence of the hard-water stream entering the compartment after the chemical charge has been delivered into it by one of the pumps. The mixture then flows into one of two sixteen by thirty-foot tanks. When the tank is filled, water is pumped from the top of the tank and forced in through perforated pipes lying in the sludge at the bottom. By this means a thorough stirring and sludge contact are secured, both of which are beneficial. A period of several hours' rest then follows.

The clarified water is drawn off through floating discharge pipes and is repumped to an elevated service tank. Each plant delivers if necessary 240,000 gallons in twenty-four hours.

INTERMITTING SOFTENING PLANTS FOR HOT WATER.

Almost all chemical relations are hastened by the application of heat. Those which occur in water softening are no exception to this rule. A hot water plant can be operated with smaller tanks than a cold water one.

The Solvay Process Company's Purifying System—Onondaga lake water is used. The water is hard and saline.

	Parts per 100,000.
Calcium bicarbonate	14.38
Magnesium bicarbonate	1.32
Calcium sulphate	22.88
Calcium chloride	4.90
Magnesium chloride	72.27
Sodium chloride	97.90

Sodium carbonate (soda ash) is the purifying agent used, twenty-five per cent in excess of the calculated amount being placed in each of two 4,300-gallon tanks before the water enters. The water is at eighty degrees centigrade (having been used in condensers). It enters the tanks at the rate of 13,000 gallons per hour, which means that three tanks are filled and emptied hourly, making the cycle for one tank twenty minutes.

This plant is interesting because of the small tankage and the high rate of purification. The reaction-tank area is only two-thirds of the hourly output, and there are no mechanical devices to facilitate mixing or hastening the mechanical reaction. The high temperature of the the water to be treated and the fact that twenty-five per cent excess soda ash is used, explain the success of the process. The treated water is pumped through sand filters into the boilers. Seven filters, from four to six feet in diameter by four to five feet high are used.

The test of the feed water is regulated to seven cubic centimetres d.n.H_2SO_4 per 100 cubic centimetres of water.

After passing the filters the water contains lime salts equivalent to 2.50 parts sulphate of lime per 100,000. The boiler tubes show a dust-like coating, easily rubbed off. By blowing off at intervals the concentration of sulphate of soda, carbonate of soda and salt is kept at or below two degrees Beaumé (hydrometer test). One man on each eight-hour shift attends to the treatment.

Summary of Solvay System—Capacity: per day, 310,000 gallons; per hour, 13,000 gallons; per minute, 216 gallons.

Reaction space: 2 by 4,300 = 8,600 gallons = two-thirds of hourly output.

Filters: seven, five of which aggregate seventy square feet surface area.

2 D—CONTINUOUS METHOD.

The type of machine now referred to is the one which is so designed that the flow of water to the plant operates all necessary mechanism (stirrer, etc.). The feed of chemicals is regulated by proportioning devices. Proper mixing of chemicals with hot water takes place automatically and the water passes evenly through the machine, while the chemical reaction of softening proceeds to a finish and the mechanical action of sedimentation is almost perfectly effected. A filter at the top of the machine gives final clarification and the softened water is discharged without repumping into the storage tank.

Desrumeaux seems to have been the first to utilize by means of a water-wheel the power of the water flowing into the softening machine. He used the power for driving a stirrer in his lime tank. In both lime-water and reaction tanks, he had annular, spiral passageways for the rising water aiming to give it a steady, though curcuitous upward movement. Sludge settling on the spiral plates was supposed to slide to outlets properly placed to favor undisturbed fall to the base of the machine. The feed for chemicals was controlled by valves operated by floats in the hard-water box.

The design has been modified by Mr. C. H. Koyl. The spiral settling device has been discarded; the small lime-water tank has been replaced by a very large one, and elaborate stirrers have been placed in the reaction tank.

The lime-water tank is made large, so that it will produce practically clear saturated lime water of definite strength and not milk of lime of variable lime content. This point is important and is looked after carefully in the design of all good continuous machines. The rate of clarification varies according to whether hard water or soft water is used for making lime water.

Stirring always assists chemical reaction, but the writer does not think that stirring need be very prolonged. Machines with no stirring beyond about five minutes' mixing turn out properly softened water. The course of the water through the apparatus as effected by its internal design is a very important factor in determining the completion of reaction and sedimendation.

THE REISERT-DERVAUX SOFTENING MACHINE.

This machine has a conical or vase-shaped line saturator designed to favor clarification of the lime water. Experience with cone-bottomed but otherwise cylindrical saturators has shown that the shape is unnecessary.

The lime and hard-water flows are proportioned by micrometer valves leading from a receiver box at the top of the machine.

The method of feeding soda solution is by an adjustable siphon which rises and falls with the level of the hard water in the receiving tank. The method of mixing chemicals and hard water is, in the writer's opinion, poor and the internal arrangement of the reaction tank imperfectly planned.

An ingenious, self-cleaning sand filter occupies the upper part of the reaction tank. This device, however, failed to work satisfactorily in an installation with which the writer is familiar and may be criticised on several grounds, in any case.

THE BRUUN-LOWENER SOFTENER.

This machine differs from the Desrumeaux in its device for utilizing the water power for stirring and chemical feed. The Desrumeaux uses an overshot water-wheel and the Bruun-Lowener an oscillating or tipping-bucket. This device has already been referred to when describing the Davidson machine. Bruun has his chemical solutions (milk of lime and soda) in a semi-cylindrical tank placed above the tipping-bucket. The motion of the bucket is caused to actuate a stirrer and also a stopper valve.

The latter is raised to a definite height by a cam and then seated by a spring. A definite quantity of solution is fed in this way. Mixing of chemicals and water

is accomplished by the force of the inflowing water.

In the Bruun-Lowener plants built in this country the lime and soda solution is prepared at ground level and pumped to the feed tank at the top of the apparatus. As it is necessary to keep a constant level over the feed valve, it requires a continuous chemical supply. The hard water passing to the machine drives a circulating pump for this purpose.

It may be said of all tipping-bucket machines that the mixing occurring in the bucket and due to the motion of the inflowing water is not enough to properly inaugurate the reactions which occur in water softening. It is also true that they are not as economical of lime, and, most important of all, the chemical feed is temporarily inaccurate after a period of disuse. This is caused by the settling out of the lime. When the stirrer has worked a few minutes, the feed is normal.

THE KENNICOTT SOFTENER.

The Kennicott water softener details were worked out by Messrs. C. L. Kennicott and W. H. Green, while chemists at the Consumer Company plant at Chicago.

It differs in the following respects from other continuous softeners:

1. The chemical feed-proportioning device.
2. The use of soft water for lime water.
3. Method of mixing chemicals and hard water.
4. Means of assisting sedimentation.
5. Compact, concentric tank arrangement.

CHEMICAL FEED-PROPORTIONING DEVICES.

The proportioning devices employed in connection with continuous chemical feed in the several softening machines used in this country are:

1. Weirs (used by Industrial Water Company, also by A. B. Bellows).
2. Stopper valve actuated by tipping-bucket (Bruun-Lowener).
3. Pumps actuated by tipping-bucket (Davidson).
4. Spoons actuated by tipping-bucket (Kennicott T. B. type).
5. Fixed orifices for discharge (Reisert-Dervaux).
6. Movable and adjustable orifices for discharge (Kennicott L. P. type).

1. Weir System—The use of proportional weirs pre-supposes a smoothly flowing body of water. Mr. Bellows' plan provides stilling plants for overcoming wave motion.

The Industrial Water Company uses weirs located in a box directly under and receiving the discharge from their overshot water-wheel. Wave motion must influence measurement in such a case.

Fixed weirs serve only for proportioning lime water to hard water. Mr. Bellows has devised a movable weir (attached to a float) for use with soda-ash solution.

2. Stopper-Valve System—This plan has already been mentioned. It is for use in connection with a milk of lime and soda feed. A cam actuated by the motion of the tipping-bucket raises the valve and the spring and weighted stem seat it again.

A quantity of chemical mixture, proportionate to the time during which the valve is open, flows into the bucket compartment which has just discharged its contents.

Between runs, lime settles around the valve causing it to stick or feed too much lime before the mixer has done its work. Small bits of wood, sand, etc., may prevent the valve from seating properly and thus the chemical feed will be uneven.

3. Pump System—Two chemical feed pumps, having ball valves, have pistons connected with a walking-beam actuated by the movement of the tipping-bucket. Judging by published results, Davidson's pumps work well.

4. Spoon System—This device for use in connection with Kennicott plants up to 500 horse-power is described in United States patent 732,357. A rocker-arm has spoon-like contrivances for its ends. These dip up a definite quantity of chemical solution and discharge it into the tipping-bucket at each oscillation. It would seem much more positive and certain in its action than either stopper-valve or pump.

All tipping-bucket devices presuppose a well-stirred chemical mixture, stirrers being operated by the tipping-bucket.

5. Fixed Orifice System—In this system, orifices in the side or bottom of the hard-water receiving box are controlled by micrometer valves. The depth of the openings under water is fixed, but their size may be varied by means of the valves.

The success of this system depends on uniform discharge by the valves which can only be ensured by calibration as frequently as experience proves is necessary.

6. Movable Orifice System—This system is carried out by means of hinged lift-pipes having adjustable openings in their traveling ends.

The pipes are located in the lime-water and soda-solution measuring boxes which are always filled to the same depth.

Fluctuations of water level in the hard-water box due to increased or decreased flow of water to be softened are transmitted to the lift-pipes by means of a float and chains.

In the beginning, the discharge slot in the hard-water box is made in exact proportion to the slots in the lift-pipes in the chemical boxes. This having been done, the flow from all of these openings is kept proportional by the fact that all of the orifices are at all times under equal depths of water or chemical solution.

METHOD OF MIXING.

In the Kennicott apparatus, the soda-ash solution meets the hard water first. The mixture flows into a revolving hopper having projecting baffles. The lime water rises constantly and meets the hard water and soda just above the perforated plate which forms the top of the lime saturator.

The complete mixture then turns and flows upward, being very thoroughly stirred, until it passes over into the top of the down-comer cone which is a part of the settling system.

After the mixing and stirring have been carried out, two things are still necessary:

1. Completion of all chemical reaction.
2. Clarification or sedimentation.

For the first result, time and sludge contact are necessary.

For the second, mechanical aids to sedimentation are desirable. In the Kennicott apparatus such assistance is given by a conical bottomless down-comer so designed that the descending turbid liquid constantly loses velocity and drops most of its suspended matter before reaching the bottom of the cone. Settlement of the precipitate thus takes place with the current instead of against it.

The cross-section of the opening of the cone at the bottom is equal to that of the annular space surrounding it at that point, so that the partly clarified water in turning upward does not change velocity. In its further progress, however, its flow becomes steadily slower.

Inclined perforated plates or baffles in this section of the apparatus apparently gives the necessary steadying influence and sludge contact. A wood-fibre filter effects final clarification.

CONTINUOUS SYSTEMS FOR HOT WATER.

Any system or plant which fulfils the conditions for softening cold water will necessarily soften hot water.

Steel construction is best and smaller tanks may be used. Nevertheless, it is a mistake to sacrifice anything in thoroughness of mixing or means of securing uniformity of progress of water through the apparatus.

The typical continuous hot-water plant consists simply of:

(a.) Soda and lime-water tanks.

(b.) Separate feed pumps.

(c.) Mixing tank with baffle partitions.

(d.) Sand filter.

The chemical feed pump may be coupled up with the hard-water feed pump, but in many cases this is not done and the only means given the operator to judge of accuracy of feed is a bottle of phenolphalein solution.

As this reagent gives a pink color as soon as the free carbonic acid in the water has been neutralized, it is absurd to expect it to indicate whether lime enough has been added to decompose bicarbonates and soda enough for other lime and magnesia salts.

Hot water softening had best be carried out with an apparatus having more reliable chemical feed devices than proportional pumps.

THE ECONOMIC RESULTS OF WATER SOFTENING.

The considerations which lead to the taking up of water softening by steam users may be grouped as follows:

First—Loss of service of boilers, due to impossibility of satisfactory, continuous operation with hard water.

Second—Possibly of substantial savings in fuel and repair bills and the checking of rapid deterioration of boilers.

The cost of water softening undertaken for the first reason is not always a matter of prime importance. It must be reasonable, of course, but results are the main thing. In most cases, however, water softening stands or falls by the relation of what it costs, to what it accomplishes. The charges against a water-softening installation are:

Interest on cost of plant.

Depreciation.

Chemicals for softening.

Attendance.

Power for operation (and repumping).

The credit items for a softener are:

Fuel saving.

Repair saving.

Depreciation saving.

Increased service obtainable from steam generators.

COST OF SOFTENING PLANTS.

The best softening plants cost from $4 to $5 per horse-power for installations up to 1,000 horse-power, for 1,000 to 2,000 horse-power, the cost is $4 to $3 per horse-power. From 2,000 to 5,000 horse-power, the cost is $3 to $2 per horse-power. From 5,000 to 15,000 horse-power, the cost is $2 to $1.20 per horse-power.

DEPRECIATION.

The above figures refer to steel construction. Plants for which wooden tanks are used are sometimes offered at as high rates, but the depreciation of wooden tanks under service conditions is much greater beside other disadvantages. If steel tanks are reasonably well cared for, five per cent is more than enough to allow for their depreciation.

COST OF CHEMICALS.

The quantity of chemicals required for softening varies directly with the character of the water treated. The prices of lime and soda ash do not vary much in different sections of the country. There is, however, great choice in commercial lime, much of the building lime being so high in magnesia as to make it unfit or uneconomical to use. From ninety to ninety-five per cent lime can be had and should be insisted upon.

The cheapest waters to soften are those the hardness of which is due to carbonates of lime and magnesia only. Such waters require simply lime-water treatment. It costs only 0.2 cent per 1,000 gallons to remove 1.42 pounds of carbonate of lime (equivalent to ten grains per gallon) and only 0.48 cent to remove the same quantity of carbonate of magnesia. These amounts are sufficient to give a great deal of trouble in heaters and boilers.

The removal of sulphates and other soluble compounds of lime and magnesia from water requires the use of soda ash. It costs 1.20 cents per 1,000 gallons to remove sulphate of lime equivalent to ten grains per United States gallon. The same amount of sulphate of magnesia requires 1.36 pounds of soda ash which costs 1.36 cents per 1,000 gallons.

The cost of chemicals for softening water varies from 0.5 cent to five cents per 1,000 gallons, averaging from one to two cents.

ATTENDANCE.

The cost of attendance at softening plants varies greatly, but is never more than that of the time of one man (or boy). It is often much less. With the best type of plants two or three hours per day are all that are required for attendance unless the installation is very large. Chemical tests for control of the softening plant can be carried out by persons of average intelligence. The best plants have all stirrers or other mechanism actuated by water power. The flow of water to be softened starts everything.

REPUMPING.

Many softening plants now in existence are so designed that the softened water is discharged at or near ground level. This involves the use of a pumping plant to reelevate the softened water.

The best type of softeners are those built in the form of towers and discharging the softened water into service tanks at a level only a few feet below the point at which the hard water was received.

FUEL SAVING.

The earliest recorded researches on the subject of loss of heat caused by boiler incrustation are those of John Graham, conducted in 1850 to 1857 and published in the Memoirs of the Literary and Philosophic Society of Manchester in 1860. He says: "a scale of sulphate of lime one-sixteenth of an inch thick reduced the efficiency 14.7 per cent."

Reuben Wells ran two boilers for several months with heating surfaces covered with scale and an equal length of time later with clean heating surfaces and found a saving of seventeen and one-half per cent with clean boilers. Details of scale thickness or density are not given.

Towers cites the case of a boiler operated at the "Conservatory," France. When clean, 8.50 kilogrammes of steam were produced per kilogramme of coal. When incrusted only 3.87 kilogrammes of steam were generated per kilogramme of coal. The efficiency of the fuel was reduced fifty-six per cent.

The National Association of Stationary Engineers undertook a series of experiments on the "Conductivity of Boiler Scale." These experiments covered the rate of transmission of the heat of steam at 212 degrees Fahrenheit through brass, iron, boiler scale, plaster of paris and Portland cement. It having been found that a sample of boiler scale conducted heat at about the same rate as plaster of paris, a tube coated with the latter was used for further experiments.

Such a tube was fastened into a cylindrical vessel so that the two ends projected from top and bottom. Water in definite amount was placed around the inner tube and heated gases from a burner with constant gas supply were passed up the middle tube. It took no longer to heat to 205 degrees Fahrenheit when the heating surface was coated with plaster than with a clean tube. .

A cement-coated tube allowed the surrounding water to be heated to 205 degrees Fahrenheit in nineteen minutes, twenty-three seconds, while the clean tube gave the same result in sixteen minutes.

It is pointed out that the efficiency in this case was far from being in the ratio

of 4.71 as the relative conductivities of cement and iron would lead one to expect. The final rather remarkable conclusion is reached that a three-thirty-second-inch coating of scale would make no appreciable difference in the efficiency of a well-designed boiler.

The fact is overlooked that all boiler scale is not comparable with either plaster of paris or Portland cement coatings and furthermore, that experiments carried out at boiler temperatures and under boiler conditions would probably show much greater interference with heat efficiency.

Kent says that the amount of loss of heat due to scale deposits is often overestimated. The loss depends upon the kind of scale as well as upon its thickness, but it does not increase directly with thickness.

Kent also says that he once made a test of a water-tube boiler, the tubes of which were coated with a scale one-quarter-inch thick. He obtained practically the same evaporation as he obtained a few days later when the boiler had been cleaned. The scale was soft and porous.

Results such as these should make writers on water softening more temperate in their estimates as to the effect of scale of increasing thickness, but they do not detract from the value of the records already quoted to the effect that one-sixteenth-inch scale may cause a loss of as much as fifteen per cent of fuel especially when the boiler is worked hard. The following concrete instances have a direct bearing on the question of fuel saving due to keeping tubes clean by the use of softened water.

A "Kennicott" Plant at an Ice Factory —The Everett Audit Company, of Chicago, certified under date of September 10, 1900, that it found 16.63 per cent less fuel required per ton of block ice produced by the Consumers' company after installing a water softener.

Fuel saving at the above rate with coal at $1.35 per ton meant an economy of $4,950 per year. Lake Michigan water which was used in this case contains 12.16 parts of scale-forming solids, chiefly carbonates, per 100,000 and is classed as fair for boiler use.

BOILER REPAIR SAVING.

The Consumers' company in Chicago now requires no scale removal or boiler repairs due to bad water. This means a saving of $780 per annum at an 800-horse-power plant.

The Nichols Chemical Company reports seventy-five per cent saving in boiler repairs due to softening a moderately hard water.

It is difficult to put into dollars and cents exactly what water softening means in prolonging the life of boilers. The wear and tear on boilers using softened water would certainly average seventy-five per cent less than with untreated water.

WASHING OUT BOILERS.

A marked decrease in this item is noticed by users of water-softening plants. While the accumulation of soda salts necessitates water-changing by blowing off quite frequently, yet complete washing out for the removal of sludge and scale is much less frequently required than formerly.

The Use of Roentgen Rays in Therapeutics.

Considerable alarm is being created by the daily papers regarding the danger attending the use of Rœntgen rays. It has been affirmed that many medical men who have been in the habit of handling and using X-ray tubes are now suffering from a peculiarly painful disease which closely resembles cancer. This "disease" attacks the skin, and is said to be incurable. Until there is definite medical testimony to the contrary, however, we refuse to believe that cancer can possibly result from the application of X-rays. It is, perhaps, just conceivable that repeated X-ray burns might, in particularly adverse circumstances, cause the tissue to get into such a condition that it may fall an easy prey to cancer. But is it equally conceivable that the same effect might ensue from a neglected wound or blow, which tends to enfeeble the tissue? Any discovery connected with electrical science is still set down as mysterious by the mystery-loving public, and the cause of cancer is still unknown; the vulgar mind loves to force a connection between two "mysteries," whether they be those with which men of science are concerned or those of Scotland Yard. So far as regards the X-ray burns themselves, although our sympathies are naturally with the men who are suffering from this painful ailment in the cause of humanity and science, it must, nevertheless, be remembered that if due care is taken by the operator to shield himself by proper screens, no danger of X-ray dermatitis need exist. If, however, the present scare will diminish to some extent the number of unqualified persons who apply X-ray treatment, we shall have no cause to regret it.—*Electrician, London.*

An examination for assistant electrical engineer will be held by the State Civil Service Commission. Application must be made to Charles S. Fowler, chief examiner, Albany, N. Y., before November 28.

BOOK REVIEWS.

"Experiments with Alternate Currents of High Potential and High Frequency," with an appendix by the author on the transmission of electric energy without wires. Nikola Tesla. New York. McGraw Publishing Company. 162 pages. 5¼ by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This is a new edition of Mr. Tesla's classic lecture before the Institution of Electrical Engineers, of Great Britain. It will be remembered that the first public presentation of Tesla's brilliant and original research in the field of high-frequency alternate currents was made before the American Institute of Electrical Engineers in 1891. As a result of this paper, Mr. Tesla received invitations from foreign societies to lecture before them, and accepted the invitation of the Institute of Electrical Engineers, of Great Britain, as mentioned above. In this lecture Mr. Tesla described and showed experimentally a number of wonderful effects, some of the experiments seeming to contradict the accepted laws of electrical action. This volume contains an appendix by the same author, on the transmission of electric energy without wires, and a new portrait and a biographical sketch of Mr. Tesla.

"Notes on Light." William Rollins. Boston. Published by the author. Cloth. 400 pages. 7 by 10 inches. 151 plates. Supplied by the ELECTRICAL REVIEW at $6.

In the preface the author states that these notes are a record of impressions derived from the experiments made after the day's work as a recreation, yet with the hope of learning to design and erect apparatus for his friend, Dr. F. H. Williams, who has done the most to show the importance of X-light in medical diagnosis. It is quite probable that no other work yet published on this important phase of electrotherapeutics has been so ambitious as the present volume. Mr. Rollins seems to have touched upon every conceivable phase of the subject. The major portion of these notes have already appeared in the ELECTRICAL REVIEW, covering a period from 1897 to the present day. While there is always opportunity for considerable criticism of an author's method in attacking a subject of this kind, we feel sure that what Mr. Rollins has done will be appreciated by a large circle of readers. The book is splendidly printed on deckle-edged paper of the finest quality, and the illustrations have been made for the book, with the result of placing the volume, from the point of view of typographical excellence, very much in a class by itself.

Coal and Ash-Handling Machinery at the Power Station of the Scioto Valley Traction Company, Columbus, Ohio.

THE Scioto Valley Traction Company operates an important electric system in the vicinity of Columbus, Ohio. The lines which are at present in operation connect Lancaster and Circleville with Columbus, the cars to the latter city running over the tracks of the city's system. The power-house is located near Big Walnut creek, at the point where the road is crossed by the line to Circleville. The station equipment consists of four Franklin water-tube boilers equipped with Roney stokers and operated at 150 pounds pressure. Within the station there are, at present, two steam-driven generators. The engines are horizontal, cross-compound, Hamilton Corliss engines. The generators were manufactured by the Bullock Electric Manufacturing Company, Cincinnati, Ohio, and operate at ninety-four revolutions per minute, delivering three-phase current at twenty-five cycles per second, 375 volts. They are rated at 1,000 kilowatts normal load, and the station has been laid out to allow for the addition of two more units.

In selecting an apparatus for the handling of coal and ashes at this plant, the engineers, W. E. Baker & Company, have made a radical departure from the method usually employed in localities where a large percentage of the coal supply is delivered in gondola cars rather than in those of the bottom tube type.

In cases where the tonnage handled is comparatively small, a common practice has been to unload cars by hand shoveling, a costly method, but one apparently unavoidable without a prohibitive investment for apparatus.

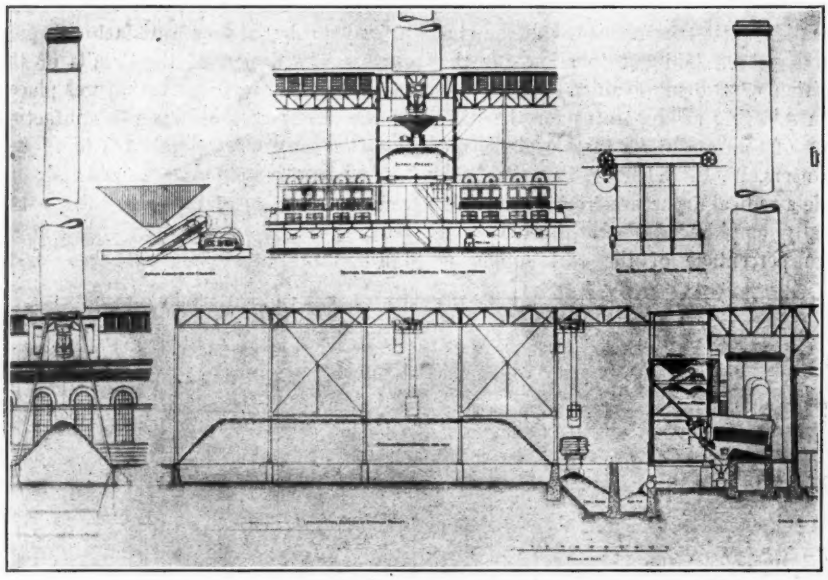
As a compromise, the method of unloading vessels with a self-filling grab bucket was thought to offer advantages for car work, and a design on these lines resulted in the installation of what has proved to be a very satisfactory apparatus. The design of the details of the machinery and its construction was placed in the hands of the Jeffrey Manufacturing Company, of Columbus, Ohio.

Two arrangements were considered; one contemplated a coal pocket above the boilers, extending the entire length of the building, over which a bucket was to be run, depositing its contents in the pocket, from which the coal could be spouted to the furnaces.

This plan was discarded on account of the cost of the structural work necessary and the scheme shown on the accompanying drawing was adopted and is described briefly as follows: the cars are set in the position indicated and if of the dumping type are emptied into the pocket under the track. Gondolas are

BOILERS IN THE POWER STATION OF THE SCIOTO VALLEY TRACTION COMPANY, COLUMBUS, OHIO, EQUIPPED WITH AUTOMATIC COAL SERVERS.

unloaded with a grab bucket suspended from a trolley traveling on an elevated runway, and the coal is delivered either to the storage pocket or to the supply pocket inside the building in front of the chimney.



Longitudinal Elevation of the Coal-Handling Equipment of the Scioto Valley Traction Company, Columbus, Ohio.

Over the supply pocket a screen in the shape of an inverted pyramid receives the coal from the bucket, passing the small sizes and delivering the lumps through an opening at its apex to a small apron conveyer which provides a uniform feed to a crusher.

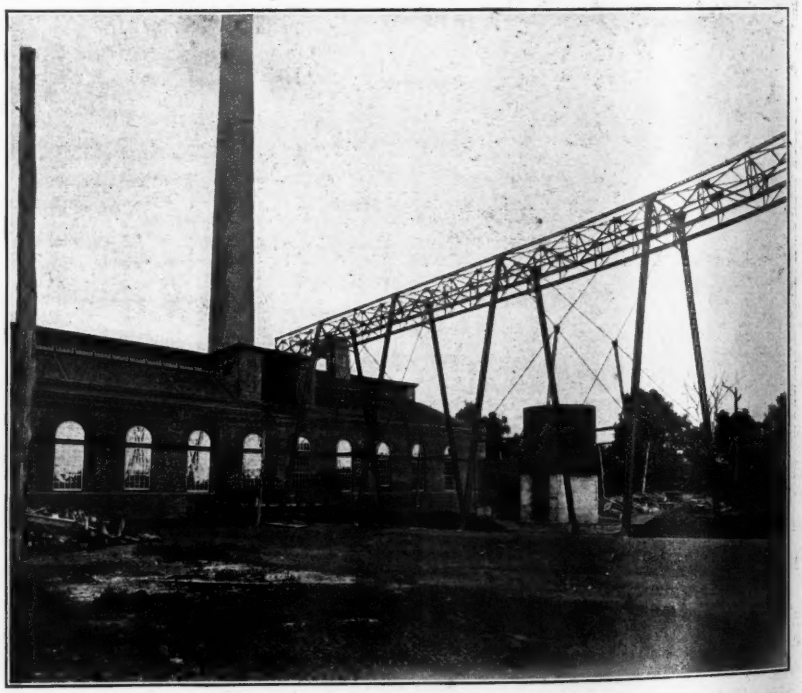
Gates in the bottom of the supply pocket serve to fill a traveling hopper running in front of the boilers at right angles to the travel of the bucket. From this hopper the coal is delivered to the stokers as required.

The grab bucket has a capacity of one and one-half tons, and is suspended by a steel cable from its hold and hoist mechanism on the trolley. The holding and hoisting drums are operated by a twenty-horse-power motor, and the trolley is equipped with a five-horse-power motor for traversing it on the runway. The apparatus is controlled by an operator from a cage suspended from the trolley frame.

A twenty-five-horse-power motor operates both the crusher and feed conveyer, and the traveling hopper is provided with a two-horse-power motor controlled from the boiler-room floor. All motors are wound for 125 volts, direct current, and are provided with all necessary control apparatus.

The capacity of the unloading plant is twenty tons per hour, of the storage pocket 1,000 tons and of the current supply pocket 100 tons or sufficient to carry the plant over night.

Ashes are removed in hand cars from the brick-lined, plate-steel hoppers provided under the boiler grates, dumped into a pit and loaded on cars by the grab bucket for removal.



Exterior View of Coal-Handling Equipment of the Power Station of the Scioto Valley Traction Company, Columbus, Ohio.

Photographs and details of some of the interesting features are shown.

RELATIVE EFFICIENCIES OF ELECTRIC AND HYDRAULIC ELEVATORS.[1]

BY WILLIAM C. L. EGLIN.

Steam and hydraulic elevators were introduced about fifty years ago. Steam elevators are now obsolete, except in a few special instances. There are three types of hydraulic elevator, viz.: the vertical cylinder, the horizontal cylinder and the plunger type. These may be either high or low pressure, or one machine may combine both high and low pressure. Electric elevators were first invented less than twenty years ago, and only in the last ten years has serious attention been paid to their development. They may be divided into three classes—drum type, screw type and differential type. The differential type of elevator is new, and is operated by two variable speed motors driving a continuous-running rope. The elevator car replaces the tightener weight of the driven rope. Its upward or downward motion depends upon the relative speed of the two motors. The hydraulic elevator, operated by an electrically driven pump, is known as an electric-hydraulic elevator, but it can not really be considered as an electric elevator. Comparisons of electric-hydraulic elevators are limited to comparisons of the steam and electrically driven pumps.

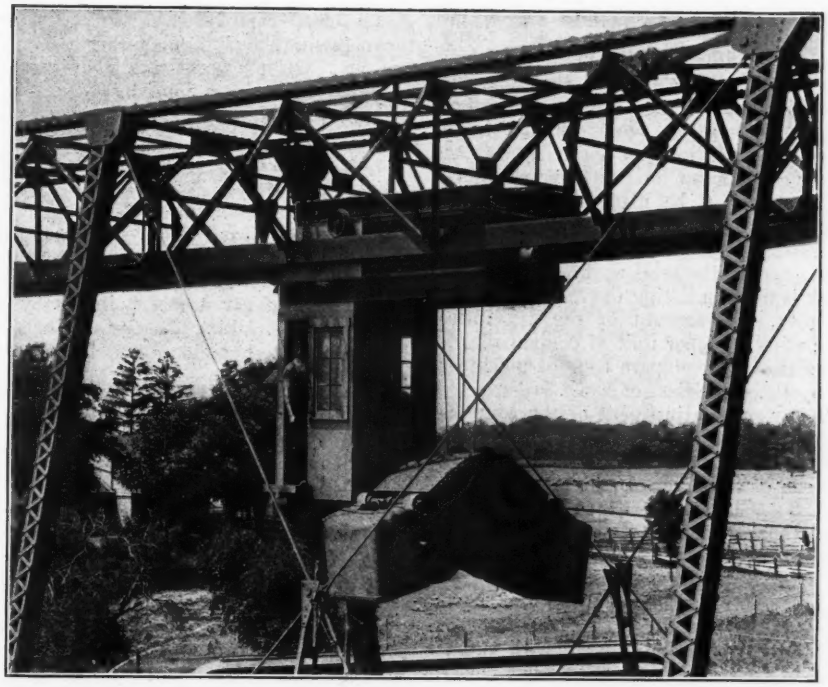
In comparing the relative efficiencies of

[1] Abstract of a paper read before the Association of Edison Illuminating Companies, Newcastle, N. H., August 30, 1904.

elevators there must be considered, first, the efficiency of the machine in doing its work—that is, its ability to start and to stop quickly, and to be under control without requiring great skill on the part of the operator; second, the ability of the machine to do its work with safety to the passengers and attendant; third, the mechanical efficiency of the different types.

In the first comparison, the method of controlling, starting and stopping is of the greatest importance. With slow speeds and light cars a hand rod or rope running through the car is satisfactory. On high-pressure hydraulic types a pilot valve is added to the mechanism to assist the operator to move the heavy valves. A lever or hand-wheel used to operate the rope also assists the operator. The disadvantages of the control rope are due to slack rope, looseness in the various parts of the mechanism, varying tension in the lifting ropes, etc.; hence constant attention has to be given to the controlling mechanism in order to maintain hydraulic elevators in good condition. In the plunger type of hydraulic elevator the defects are limited to the operating rope and its mechanism.

Electric elevators may be controlled electrically or by a hand-rope operated either by a wheel or lever. The electric control may be effected either by a pilot motor or magnetic switches, or by the actual control of the motor current from the car. Some drum type elevators are controlled by hand-ropes. The starting of the motor is effected by means of a starting box, and the elevator is stopped and held by a brake. This requires considerable skill on the part of the operator, as his ability to make landings depends on the brake adjustment. The screw type electric elevator is controlled by means of a pilot motor. In the differential type of elevator the speeds of the motors are directly under the control of the operator. The field rheostats and the two motors are operated by a single lever. This type of elevator is expensive to maintain, on account of the wear on the continuously running cables.



THE TRAVELING CARRIAGE AND BUCKET, COAL-HANDLING EQUIPMENT OF THE SCIOTO VALLEY TRACTION COMPANY, COLUMBUS, OHIO.

THE ASH-HANDLING ROOM, SHOWING ASH DUMP, POWER STATION OF THE SCIOTO VALLEY TRACTION COMPANY, COLUMBUS, OHIO.

The second comparison is the ability of the machine to perform its work with safety to passengers and operator. Safety devices should be installed on all types of elevators. The plunger type of elevator usually is not equipped with devices to prevent the car falling in the event of the plunger rod breaking. It is assumed that the plunger is made with a factor of safety so large that there is no danger of its breaking; but with the high lifts in tall office buildings, safety devices should be used to prevent the car from falling if the plunger breaks. Other safety devices should be provided to hold the car if its speed exceeds a certain safe limit, due to any cause whatever, and to prevent the car over-running at either the top or bottom.

It is difficult to compare the mechanical efficiencies of electric and hydraulic elevators, on acount of the inability to obtain comparisons of machines doing relatively the same amount of work. In examining the work done by an elevator, the size and speed of car, number of passengers, number of stops, and class and height of building must all be considered.

Hydraulic elevators usually require power only in lifting, so that the power required is divided by two for the number of car-feet traveled to obtain the power per car-mile. The use of the unit "car-mile" consumption of power has caused many misunderstandings of the relative efficiencies of different classes of elevators. A car operated at low speed, with few stops, requires less power than a high-speed elevator making many stops. A better comparison for passenger elevators, at least, might be made in "passenger-feet" than in car mileage. The work done in lifting passengers is, however, only a small part of the total work. Most of the work is done in lifting the car or counterweights. On account of the difficulties of finding a proper unit of comparison, it is necessary to compare tests of machines doing the same class of work.

The proper adjustment of the counterweight is a large factor in the efficiency of the elevator. This is shown by a comparison of tests Nos. 6 and 7 below.

A synopsis of a number of tests made by Mr. H. Calvert, on elevators of various classes in various buildings in Philadelphia, is here given.

Test No. 2, Edison Building, Tenth and Sansom streets. Morse, Williams & Company, hydraulic elevator, with motor-driven pump. Motor, fifteen horse-power, 220 volts. Pumps, six and one-half inches by twelve inches, fifty-four strokes per minute, five-inch discharge from pressure tank to elevator cylinder. Motor automatically stops when pressure reaches eighty-seven pounds, and starts when pressure falls to seventy-five pounds. Car, 5 feet 8 inches by 3 feet 10 inches. Lift of elevator, 76 feet 5½ inches. Elevator installed April 30, 1896. Tested February 29, 1904. Duration of test, 10 hours, from 8 A. M. to 6 P. M.

Total distance traveled....	50,813	feet.
Feet per minute, including stops	84.69	
Total passengers carried...	1,457	
Average distance per person carried.....	35	feet.
Number of stops.....	1,853	
Total watt-hours.....	78,000	
Kilowatt-hours per car-mile.	8.1	
Watt-hours per person per thirty-five feet.....	53.5	

Test No. 4, John Strafford Building, 1118-1120 Chestnut street. Stokes & Parish direct electric elevator. Motor, 220 volts. Maximum amperes, sixty. Speed, 800 revolutions per minute. Car supported by four cables, two to motor drum, and two to counterweight. Car, 2 feet 10 inches by 4 feet 9 inches. Lift 100 feet 8 inches. Installed June, 1901. Tested March 21, 1904. Duration of test, eight hours and twenty minutes, from 8 A. M. to 4.20 P. M.

Total distance traveled....	47,365	feet.
Feet per minute, including stops	94.73	
Total passengers carried...	879	
Average distance per person carried	54	feet.
Number of stops.....	1,052	
Total watt-hours.....	15,760	
Kilowatt-hours per car-mile.	1.8	
Watt-hours per person carried fifty-four feet.....	17.9	

Test No. 6, Penn Fire Insurance Company, 508 Walnut street. Morse, Williams & Company, plunger type hydraulic elevator. Car supported on eight-inch steel plunger. From top of car six cables run over sheave to a counterweight. The plunger is forced up by water pressure; the water is stored in a closed tank by a No. 3½ Quimby pump. The pump is direct-connected to a ten-horse-power, 220-volt, forty-ampere Eddy motor running at 1,200 revolutions per minute. The motor starts automatically when the water pressure is seventy-five pounds and stops when it is 100. Elevator installed August, 1902. Tested April 15, 1904. Size of car 4 feet 2 inches by 4 feet 5 inches. Lift, 36 feet 7 inches. Duration of test, eight hours, from 8.30 A. M. to 4.30 P. M.

Total distance traveled.....	3,242	feet.
Total passengers carried....	108	
Number of stops.....	153	
Watt-hours	3,180	
Kilowatt-hours per car-mile.	5.3	

This is a freight elevator, and the number of passengers carried is small. The calculations per passengers have therefore been omitted, as they would be unfair to the machine.

Test No. 7, J. E. Caldwell & Company, 902 Chestnut street. Stokes & Parish electric hydraulic plunger elevator. Car is supported on an eight-inch steel plunger, and is not counterweighted. Pressure is maintained by a No. 4 Quimby pump, direct-connected to a fifteen-horse-power, 230-volt motor running at 1,100 revolutions per minute. The motor is controlled by a pressure regulator, starting at 100 pounds and stopping at 118 pounds. Car, 3 feet 3 inches by 6 feet 3 inches. Lift, 34 feet 6 inches. Elevator installed August, 1901. Tested April 18, 1904. Duration of test, 9¾ hours, from 8 A. M. to 5.45 P. M.

Total distance traveled.....	7,857	feet.
Feet per minute.....	13.4	
Total passengers carried....	351	
Average distance per passenger carried.....	22.4	
Stops	388	
Total watt-hours.....	25,200	
Kilowatt-hours per car-mile.	16.91	
Watt-hours per person carried per 22.4 feet.....	71.8	

Test No. 9, Gimbel Brothers' store, Market and Seventh streets. Stokes & Parish direct electric elevator. Motor, twenty horse-power, 220 volts, eighty-five amperes, 800 revolutions per minute. Motor is connected by worm and two wheels to elevator drum. Car is supported by four cables, two to drum and two to counterweight. Car, 5 feet 7 inches by 6 feet. Lift, 120 feet 5 inches. Installed July, 1897. Tested May 2, 1904. Duration of test, 9½ hours, from 8 A. M to 5.30 P. M.

Total distance traveled....	32,237	feet.
Feet per minute.....	67	
Total passengers.....	4,022	
Total stops.....	1,914	
Total watt-hours.....	46,960	
Kilowatt-hours per car-mile.	6.66	
Watt-hours per 1,000 passenger-feet	184	

CONCLUSIONS.

In considering the mechanical efficiencies of hydraulic elevators, the number of passengers carried represents only a small proportion of the work done, on account of large losses in the machine and its auxiliaries, particularly the pressure tank and counterweight load. The only comparison of efficiencies which therefore can be made is the maker's statement of the mechanical efficiency. One manufacturer gives the mechanical efficiencies of the various types as follows:

Vertical type, hydraulic...	52	per cent.
Horizontal type.....	44	"
Plunger type.....	33	"
Drum type, electric.....	60	"

These figures do not include any losses in the pumps or piping, so that the cost of hydraulic elevator service depends upon the cost of the power at the pump. Where steam power for the pumps is used for this purpose only it is necessarily costly. The criticism of electric elevators is that they are limited as to length of car travel by mechanical limits of the stresses on the drum, the width of the drum being further limited by the size of the shaft. There is practically only one type of electric elevator being used, namely, the drum type, which is of relatively poor control as compared with the hydraulic or plunger type.

From the experiences of the users of elevator service, the principal requirement is the ability of the machine to do the work as rapidly and effectively as possible. The owner places this as the first requirement, and also demands that the cost of repairs and maintenance be as low as possible. The first cost is secondary to efficient service, and it is for this reason, therefore, that the plunger type is at present so popular. The ease of control and the ability to make landings satisfactorily have, in many cases, decided its installation, even though it is the most costly type of elevator. The vertical cylinder hydraulic elevator adapts itself readily to most of the high office buildings.. It can be operated at all speeds. The operation is simpler and more effective than even the drum electric at slower speeds.

The development of the electric elevator has practically ceased, with the exception of mechanical improvements in the drum type, so that to-day it is unable to compete successfully in all classes of elevator work. The improvements to be expected are, first, perfecting the method of control, and there seems to be no reason why this should not be accomplished; second, in developing types of machines so that requisite speeds can be attained for any length of travel. As the electric motor possesses inherently a greater variety of methods of control than hydraulic or steam motors, it would appear that the cooperation of the engineers of the supply companies with the elevator builders, in an organized effort to develop and improve the electric elevator, would soon produce a machine which would excel in operation any of the previous types, and allow the supply companies to enter all fields of elevator practice.

Electrical Notes from Europe.

By Our Special Correspondent.

THE total length of subway which Paris will possess when the present system is completed will be no less than forty miles. The work is now being carried out in sections, and at present two of the sections have been completed. The latest is the new line which was opened to the public in the latter part of October. It runs across the central part of the city and connects at each end with one of the existing lines. It passes the St. Lazare depot, the Opera and the Bourse, and as it lies in the heart of the city, there is no doubt that it will receive the heaviest traffic of any of the present lines. With this end in view, some of the stations have been made considerably larger than the standard type, and to avoid risks of accident, in case of fire, the new stations have safety exits and special ventilating shafts. The line runs entirely in tunnel. One of the remarkable points of construction is the huge masonry and ironwork block which lies in front of the Opera. It contains three superposed tunnels, as in the future there will be three roads crossing at this point. At present the new line occupies the upper tunnel. Staircases will lead down to the lower tunnels and it is proposed to use electric elevators, as to mount from the lowest tunnel to the surface will be equivalent to climbing up a five-story building. There are seventeen underground stations on the new branch. The final inspection of the new road by the official commission has just been terminated.

The central electric light and power station of Rotterdam, Germany, has been developed considerably of late, and is now one of the largest plants in the country. Besides the energy required for the lamps and motors in the city, it also supplies a large amount of current for the powerful electric cranes which are situated in the port. The central station contains an extensive boiler and dynamo room and large switchboard apparatus. The boiler room is equipped with two Willmann boilers, having 250 square yards heating surface. The boilers are fed by two pumps which deliver 1,000 gallons per hour. At present, the dynamo room contains three different sets of generators. The first set consists of two Willans engines of 170 horse-power. Each is direct-coupled to a 112-kilowatt dynamo which delivers from 500 to 700 volts. The dynamos operate at 350 revolutions per minute. Next is a direct-coupled group consisting of a 260-horse-power engine and a 180-kilowatt generator. More recently two engines of 260 and 560 horse-power, respectively, have been installed in the plant. Each of these is direct-connected to a generator which delivers 500 to 700 volts. The circuits of all the machines run to the main switchboard, from which a line passes to the two principal substations within the city. One of the substations is used mainly to supply the lighting circuits for the city, while the second station furnishes current for the electric cranes and is operated mainly during the day. The first substation, which is located 1.2 miles from the central plant, contains a large battery of accumulators which works in connection with two direct-coupled booster groups consisting of motor and generator. The latter act as boosters for regulating the charging current of the battery, or as reserve sets for the main current supply. The second station, which operates the cranes, is about two miles off and is disposed on the same general plan. It operates the forty-six electric motors which are contained in the twenty-five large cranes of the port. The total number of motors on this circuit is about 150 at present.

A large electric crane has been lately erected at Glasgow, Scotland, for handling the cargoes of the vessels. The electric equipment of the crane has been installed by the Union Electric Company, of Berlin, while the mechanical part is built by the Beurath Machine Company. The crane consists of a central tower which travels along a track. The tower carries a projecting structure or arm on each side, and along the arm is laid a track for the motor-driven carriage which travels back and forth, at the same time the weight is raised and lowered. The longer arm is 150 feet long and the shorter, eighty-five feet. The tower makes a complete revolution in ten minutes and is operated by an electric motor placed in the base. The crane can handle a load of 150 tons, which is raised at the rate of five feet per minute, while the carriage can travel at the rate of twenty-five feet per minute. The motors for lifting the load have a capacity of sixty horse-power each, and operate on 440 volts at 530 revolutions per minute. Each of the traveling carriages has a sixteen-horse-power motor which works at 600 revolutions. The whole crane is operated by six controllers which are placed in a central cabin on the upper part.

An international conference is soon to be held in Berlin, Germany, with a view of bringing about an understanding between the different governments as to the use of wireless telegraphy on the coast. The main object of the conference is to draw up a set of regulations so that the ships of all nationalities can exchange telegrams with the coast in any part of the world. In order to obtain this result the governments must come to an accord as to where the stations for public use are to be located and also regarding the use of the electric apparatus, so that the messages will not interfere with each other. The congress will be attended by delegates from the leading countries.

The Russian government is now installing a system of wireless telegraphy across lake Baikal. The width of the lake is twenty-four miles and there will be no difficulty in working the apparatus at this distance. One station is placed at Baikal and the other at Tanha. It was at first proposed to use the Russian Popoff system of apparatus, but finally the Slaby-Arco-Braun system has been adopted. The apparatus is constructed by Siemens & Halske, of Berlin, and the previous tests showed that it would cover at least twice the distance across the lake. According to the latest reports, the apparatus has already reached the spot and the Baikal station is now being installed under the direction of a German engineer. The outfit will consist of two masts 150 feet high, placed 200 feet apart. The masts will be connected by a steel wire. The station building containing the apparatus will be placed midway between the two masts. The wireless telegraphy plant is located not far from the railroad station of the Trans-Siberian. On the other side of the lake will be erected a similar outfit, and each will be supplied with current from a generating plant in the vicinity. Apropos of aerial telegraphy in Russia, it is reported that the Russian branch of the Siemens & Halske Company has recently formed a special department which is to take up

the construction of the Popoff apparatus. The company has made a combination as to wireless telegraphy with the Berlin Aerial Telegraph Company, and the inventions of Popoff and those which belong to the latter firm will be used conjointly.

A number of large central stations is now being erected in Roumania. Among these may be mentioned the plant which is in construction at Bucharest. The station is to be an extensive one, and will furnish current for the city lighting and also for a new electric traction line which will be fifteen miles long. The first equipment for the tramway will be twenty motor cars and five trailers. The station is provided with vertical compound engines of 250 horse-power, which are direct-coupled to dynamos supplied by the Helios Company, of Cologne. Another large central station is now located at Braila with about the same equipment as the former. It has been running for some time past.

Among the leading Swiss mountain roads is the Mt. Salène incline, which rises to a height of 4,000 feet above the city of Geneva to the station of Treize-Arbnes at the summit, from which a splendid view of the lake is to be had, and over the mountain region with Mt. Blanc in the distance. The road uses motor cars which climb up the steepest portion on the rack-and-pinion system. The track is one-metre gauge and uses a third rail for the current. The motor cars are equipped on the Thury system and use two forty-horse-power motors. They work on the rack rail by a thirteen to one reduction gearing, and travel at a speed of five to ten feet per second. Current is taken from the rail by two bronze shoes at each side of the car. The grades of the road are exceptionally steep and the heaviest grade, which occurs in the upper part of the line, reaches twenty-five per cent. The total length of the line is 5.5 miles. The question of brakes naturally occupies the first place when working on such a steep grade, and the cars are equipped with three brake devices, two of which are electrical. In the first case, the current is reversed in the motor for a sudden stop, while in general it is preferred to operate the motors as generators and the current is sent into a set of resistance coils. Current for the line is supplied from a hydraulic station which is located on the Arve.

Prince Henry of Prussia is to accept the nominal patronage of the International Automobile Show which will be held in Berlin, Germany, from February 4 to 19 next. The organization committee of the exposition, which will be held in the large building devoted to such events, is composed of the Duke of Ratibor, president; General Becker; Baron von Brandenstein, commissioner general; Councilor of Commerce Goldberger; Dr. Leving-Stölping; Count von Sierstorpf, and other prominent persons. The exposition is to be held under the direction of the German Automobile Club and the Syndicate of Automobile Industries.

St. Petersburg possesses a municipal lighting and power station which is one of the largest in Europe. It contains seven direct-connected steam units. These groups are each formed of a 1,200-horse-power horizontal engine and a monophase alternator which gives 3,000 volts. The dynamo is mounted upon the flywheel of the engine with the exciter placed on the end of the shaft. These machines furnish the high potential directly upon the main line circuit. The voltage is lowered in a number of transformer posts which are placed in different parts of the city. The secondary circuits work at 100 volts.

Among the large stations which have been recently erected in Australia, may be mentioned that of Ipswich, Queensland. The British Westinghouse Company supplied the electrical equipment. The new station is laid out to supply current for the government railroad shops. The station building contains a large boiler room and a dynamo room. The boiler plant consists of four units of 2,825 square feet heating surface each. The furnaces have a grate surface of sixty-five square feet and are equipped with mechanical stokers. The main dynamo room contains three principal generating sets of 200 kilowatts each. They are made up of compound engines which are direct-coupled to biphase alternators. These machines deliver 220 volts and operate at sixty cycles. The exciting groups, which are also direct-coupled, consist of twenty-kilowatt dynamos with engines which work at 350 revolutions per minute. Current is supplied to fourteen different shops which occupy a large extent of ground. The circuits from the central plant are all laid underground.

The question of using electric traction on the Caucasus railroad is now being agitated in Russia. The matter is exposed very clearly in the paper which G. O. Grafts recently read before the Electrotechnical Society. By using electric traction the trains can be run on steeper grades than usual and is therefore specially adapted for railroads in mountainous regions. Another point in its favor lies in the fact that these regions generally contain the waterfalls which can furnish the power for the road. These conditions apply very well to the Caucasus region, for there are a great number of rapid streams which could furnish a large amount of current. As to the expense of a line of road which would be built along the rocky coast of the Black sea and a central station for 30,000 volts with substations and wiring, this he figures at $5,000,000 more than for a steam railroad, basing his estimate on several of the new electric railroads in Europe. But as to the yearly expense of operating, the electric system would be far cheaper, as it figures an economy of $6,400 per mile annually as compared with steam. Again, seeing that steeper grades would be used, the construction of the track would cost less. The Electrotechnical Society has appointed a special commission to investigate the question.

When fully completed, the Ladernier hydraulic plant will be one of the largest in Switzerland, as it is laid out for a total of 10,000 horse-power. The water for the turbines is brought from the lake of Joux, which lies at a high altitude in the mountains, down into the valley, which contains the station, by a high-pressure penstock. At present there are five turbine-dynamo units installed in the station, besides two small units for the exciting current. The main generating sets are formed of 1,000-horse-power turbines, each of which is direct-coupled to a 1,000-kilowatt machine of the Oerlikon pattern. These dynamos deliver biphase current at 14,000 volts and fifty cycles. The exciters are driven by 150-horse-power wheels and give 750 amperes each, at 125 volts. The extensive system of switchboards forms one of the features of the Ladernier plant. Behind the marble panels is a cement-lined room which contains the bus-bars in one part, while another space is devoted to the transformers. The lightning arresters, with their liquid resistance and choke-coils, are mounted upon a horizontal iron framework where they are easily accessible. Most of the switching devices are connected by an interlocking system, so that no mishaps can occur from this cause.

C. L. DURAND.

Paris, October 29.

The Westinghouse Single-Phase, Alternating-Current Railway System for Interurban Service.

THE rapidity with which old standards are replaced by new and the slight extent to which electrical practice is hampered by tradition or adherence to established methods, finds an example in the change in sentiment regarding the possibilities of the single-phase series motor for traction purposes that has taken place since Mr. B. G. Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company, first made public the results of his researches along this line. Three years ago European engineers were devoting their efforts to overcoming the inherent defects of the polyphase motor for railway service and had, evidently, finally decided to use polyphase systems. American engineers were sceptical as to the ability of any one to produce an alternating-current railway system that could be operated economically or satisfactorily, or alternating-current motor. In addition to these, a number of forty-horse-power motors of this type had been operated continuously for nine months in a certain outside manufacturing plant. Since that time the Westinghouse engineers have been actively engaged in perfecting the details of the other apparatus required to complete the system. For nearly two years a car equipped with these motors has been in almost daily use upon the interworks railway between East Pittsburg and Wilmerding, and systems of regulation and control suited to various operating conditions have been devised. Figs. 1, 2 and 3 illustrate several physical features of this system.

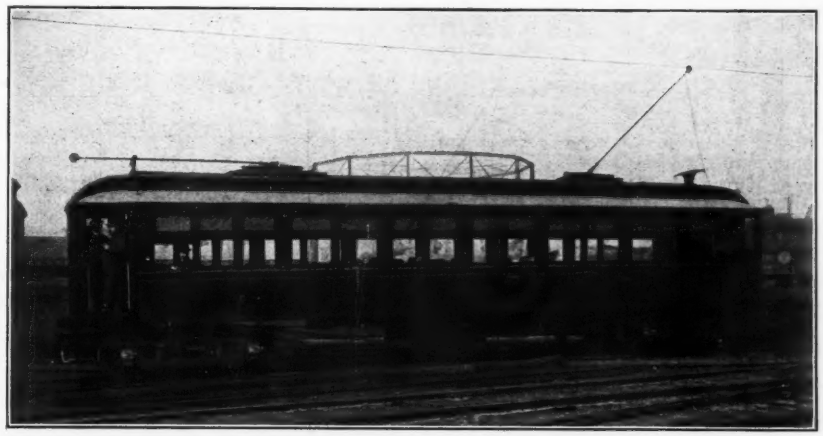


FIG. 1.—CAR EQUIPPED FOR 1,000 VOLTS OR LESS, SINGLE-PHASE, ALTERNATING CURRENT.

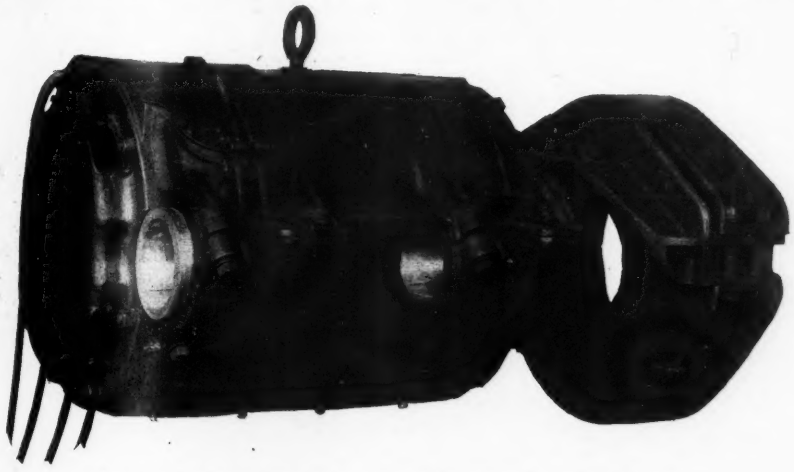


FIG. 2.—WESTINGHOUSE ALTERNATING-CURRENT RAILWAY MOTOR.

alternating-current motors with the proper characteristics for railway service. This was shown by the many doubts expressed at the meeting of the American Institute of Electrical Engineers, September 26, 1902, where Mr. Lamme presented his first paper. To-day, the general verdict is that the alternating-current railway system is not only practicable, but by some it is believed that alternating current is destined to become the motive power in general use for traction purposes.

The alternating-current railway motor is not a new and untried experiment. Previous to 1902, when Mr. Lamme first publicly advocated the use of single-phase alternating current for railways, a long series of tests at the Westinghouse shops had demonstrated the value of the series

The Westinghouse single-phase motor was described in this journal[1] and without repeating the description here, we may pass at once to the other parts of the system. It is stated that the motor possesses the same speed and torque characteristics and practically the same weight per horse-power as the best direct-current motors now in use. It is, in effect, a straight series motor carefully designed for use on alternating current. The chief feature lies in the fact that its development allows the use of alternating current throughout the entire system.

To the merits of the direct-current railway system, which the alternating system retains, are added others peculiar to the use of the alternating current. Promi-

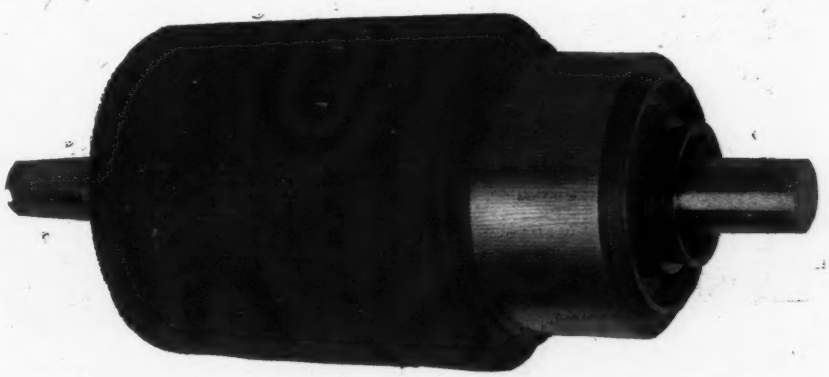


FIG. 3.—ARMATURE OF WESTINGHOUSE ALTERNATING-CURRENT RAILWAY MOTOR.

[1] ELECTRICAL REVIEW, October 4, 1902.

nent among them are the removal of the voltage limit, which lessens the cost of transmission and, also, simplifies the problem of collecting large amounts of power through moving contacts for the operation of heavy trains; the higher efficiency of transformers as compared with direct-current rotary converters in substations and an increased car efficiency by the elimination of rheostatic losses; a wide range of speed control, and the overcoming of electrolysis. There is said to be also a material saving, both in initial expense and the cost of operation and maintenance. The cost of the alternating-current car equipment is considerably more than that of the direct-current, but with the alternating-current system there is a saving in transmission circuits and the omission of the rotary converters in the alternating-current system, and the saving in other respects leave a large balance in its favor.

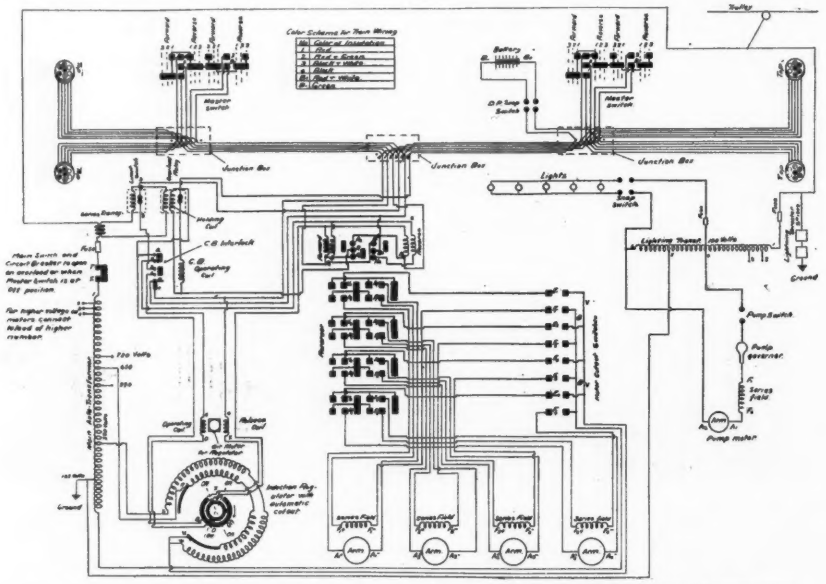


FIG. 4.—WIRING DIAGRAM OF ALTERNATING-CURRENT, SINGLE-PHASE CAR EQUIPMENT.

CAR WIRING.

There are three electric circuits upon each car, as shown upon the accompanying diagram, Fig. 4.

1. The motor circuit. In this circuit there are placed the circuit-breaker, main transformer, induction regulator, reverser, motor cut-out switches and motors.

2. The auxiliary control circuit. An electropneumatic system of control is used, the various parts being operated by compressed air controlled by magnet valves. Current for the magnet valves is obtained from a fourteen-volt storage battery placed under the seat of the car. The use of a separate low-voltage circuit for this service is a valuable factor of safety. The fact that the control circuit is independent of the line and can be used whether the trolley is in use or not is also an advantage.

3. The lighting and heating circuit. This contains the necessary apparatus for lighting and heating the car, and also the air-compressor motor with its governor. It is taken from the line by a second transformer. This circuit is not connected with the motor circuit.

MOTOR CIRCUIT.

The motor circuit begins with an autotransformer of special design connected between the trolley wire and the ground. This transformer is so arranged that the current of air created by the motion of the car circulates through it, thus keeping it cool. A view of this transformer as mounted beneath a car may be seen in Fig. 5. At a point approximately 230 volts from the ground a circuit is led from this autotransformer through the secondary of the induction regulator, and another tap, approximately 650 volts from the ground, is led through the primary of the regulator. The exact wiring of this arrangement may be seen in Fig. 4, and the diagrammatic arrangement in Fig. 7, which is somewhat modified for greater clearness.

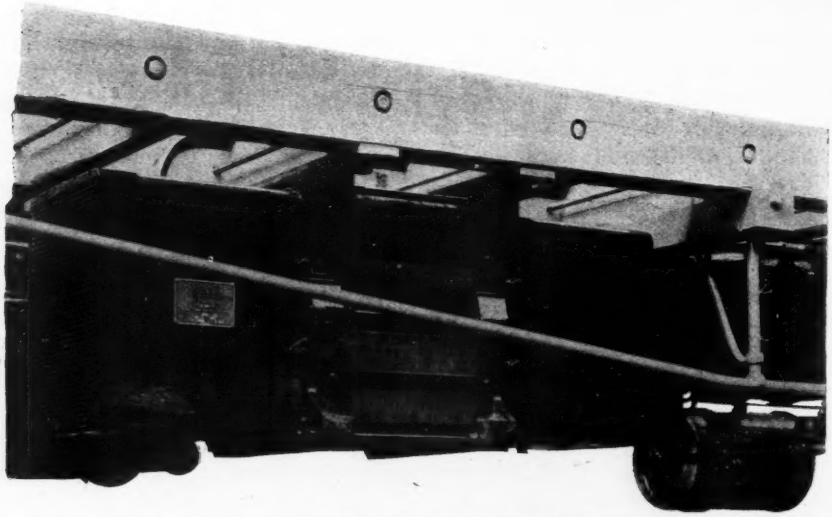


FIG. 5.—AUTOTRANSFORMER IN MOTOR CIRCUIT, OR CAR EQUIPPED WITH ALTERNATING-CURRENT, SINGLE-PHASE SYSTEM.

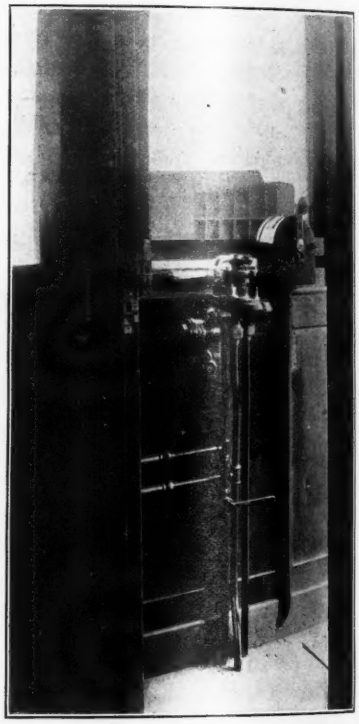


FIG. 6.—CONTROL APPARATUS FOR ALTERNATING-CURRENT, SINGLE-PHASE SYSTEM.

Between the autotransformer and the trolley is placed the circuit-breaker (Fig. 8) which also acts as a main switch and not only automatically opens the circuit when an overload occurs, but also when-

ever it is desired to cut off the current from the car. This circuit-breaker is held in place by a compressed air cylinder working against a powerful spring. When the air is allowed to escape the spring

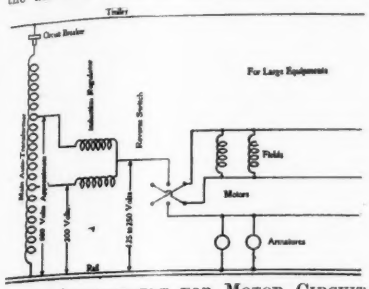


FIG. 7.—ARRANGEMENT FOR MOTOR CIRCUIT.

opens the breaker. The admission or release of air from the pneumatic cylinder is controlled by means of magnetic valves.

The voltage applied to the motors and consequently the speed of the car is governed by the induction regulator (Fig. 9). This is in effect a transformer, with its primary core and winding movable with respect to the secondary. It is operated by means of a small pneumatic motor controlled by electromagnetic valves and may be turned so that its voltage either opposes or aids that of the autotransformer any amount within the capacity of the regulator. In the "off" position the full voltage of the regulator is opposed to the 230-volt circuit of the autotransformer, thus giving a low voltage for starting the motors. At the "full-on" position the entire voltage of the regulator is added to that of the 230-volt circuit of the autotransformer, giving the proper voltage for full speed running. The regulator can be left indefinitely in either of these or in any intermediate

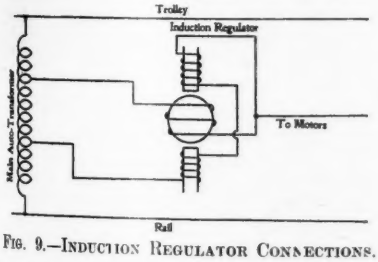


FIG. 9.—INDUCTION REGULATOR CONNECTIONS.

position, and thus the car can be run at any desired speed.

The reverser, as its name implies, changes the connections of the motor armatures with reference to their fields, so that the car may be run either forward or backward. The reverser is operated by means of two pneumatic cylinders, one throwing it forward and the other backward. Air is admitted to either cylinder, when desired, by means of a magnetic valve.

The motor cut-out switches consist of a double-pole switch for each motor, all mounted together and enclosed in a suitable iron case. In case of damage to any motor, the injured motor can be cut off entirely from the circuit, and the car then operated with the remaining motors.

The motors are permanently connected in parallel, the advantages ordinarily derived from a series-parallel arrangement being obtained directly through the use of different positions of the induction regulator, without changing the connections of the motors with respect to each other. As the motor voltage is independent of the trolley voltage, a standard of 250 volts has been adopted, irrespective of the voltage of the trolley.

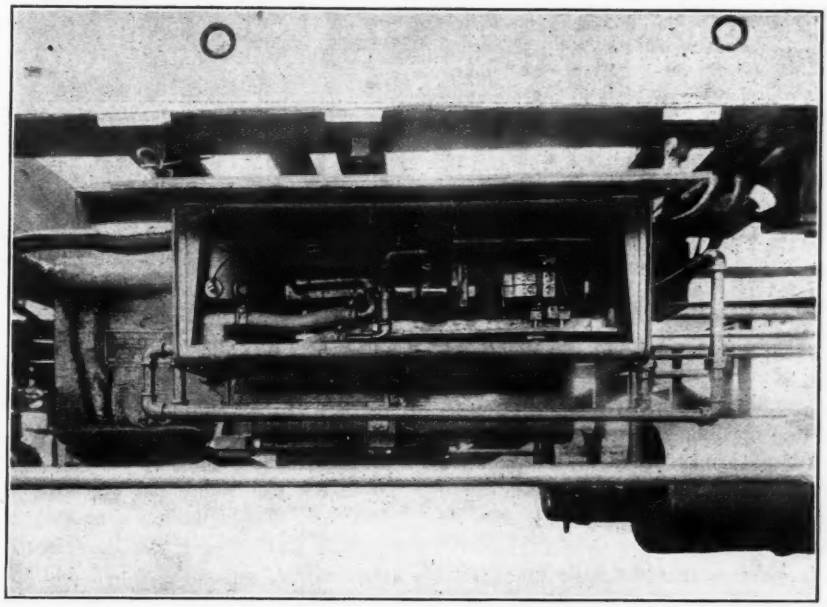


FIG. 8.—CIRCUIT-BREAKER AND AUTOTRANSFORMER.

CONTROL CIRCUITS.

The operation of the various magnet valves which regulate the movement of each of the above pieces of apparatus is controlled by means of a master switch located on the platform of the car. A view of this switch together with the motorman's air-brake valve may be seen in Fig. 6. There are but three positions for the handle of the master switch for operating the car in a forward direction, and three corresponding positions for backing. When the handle is turned to the first notch on either side, connection is made with the magnet valves governing the reverse switch. Air is admitted to the proper cylinder, and the reverser thrown to the proper position. When the reverse switch has been operated, air is then admitted to the pneumatic cylinder of the circuit-breaker and the circuit-breaker is closed. This applies current to the motors, and the car starts.

To secure a higher speed, the handle is thrown to the third notch. This closes the circuit to one of the magnet valves controlling the pneumatic motor which drives the induction regulator, and air is thus admitted to the air motor. The regulator is then turned, gradually raising the voltage at the terminals of the motors. If the handle of the master switch is left on the third position, the regulator will advance to the "full-on" position where it will be automatically stopped. If it is desired to operate the car at anything less than full speed, the handle of the master switch may be brought back to the second position and the regulator will at once stop and remain stationary. Under such circumstances, if the handle is again moved to the third position, the regulator will advance and increase the voltage at the motors and consequently the speed of the car. If the handle is moved back to the first position, the regulator will return toward the minimum position, lowering the voltage on the motors, thus lowering the speed of the car. If at any time it is desired to cut off the current, the handle of the master switch may be returned to the "off" position, in which case the circuit-breaker will open at once, thus cutting off the current immediately. After the circuit-breaker has been opened, the regulator will return toward the minimum position, and the circuit-breaker having once been opened can not be closed again until the regulator has reached the position of minimum voltage.

The circuits leading to the circuit-breaker and reverser are so intercon-

nected that the circuit-breaker can not be closed until the reverser has first been thrown, nor can the reverser be moved unless the circuit-breaker is open.

The arrangement described can be adopted for multiple control by the addition of leads, connection boxes and "jumpers" for forming a continuous control circuit over the different cars, no other change being necessary.

The advantages of this method of speed control, as compared with rheostatic control, are evident. The elimination of resistance losses, the ability to change speeds without opening the circuit, the fact that every speed may be used for continuous running and the ease and flexibility of control are important benefits thus derived.

LIGHTING AND HEATING CIRCUIT.

The lighting and heating circuit is operated from a small autotransformer similar in design to the one in the motor circuit. From this transformer are supplied the lights in the car, the heating circuits, if any, and the small motor for operating the air compressor. The latter may be controlled by an automatic governor, or by the hand switches which are conveniently located.

TROLLEY AND OVERHEAD WORK.

Where the voltage of the line is 1,000, or less, connection between the car and the trolley wire is established by means of a trolley of the ordinary type. For higher voltages, a trolley of the bow type, especially designed for the purpose, is used. This is raised and lowered by compressed air under the control of the motorman, and any danger from shock in handling is thus avoided. In Fig. 10 it is shown in the running position. The two levers at each side are so arranged that when the pneumatic pressure is removed the trolley lies flat upon the top of the car. When the air is applied, the result is first to raise the upper section at about the angle illustrated, and then to lift the entire trolley to the running position. The main spring keeps the trolley upright, but permits it to give under pressure. When the direction of the car is reversed, the upper portion of the trolley is slanted in the opposite direction. The side springs in the levers, which support the upper portion of the trolley, adjust it for variations in the height of the wire, and the trolley is thus kept in contact with it and a continuous unbroken current results. With ordinary variations, the position of the lower portion of the trolley remains unchanged, the fluctuations affecting only lighter upper sections and ensuring a sensitive action. The chief advantages given by the trolley are the substitution of pneumatic for hand control with the consequent elimination of all danger from grounding through the hand rope; a continuous contact with the trolley wire, and the impossibility of the trolley slipping and damaging the overhead structure.

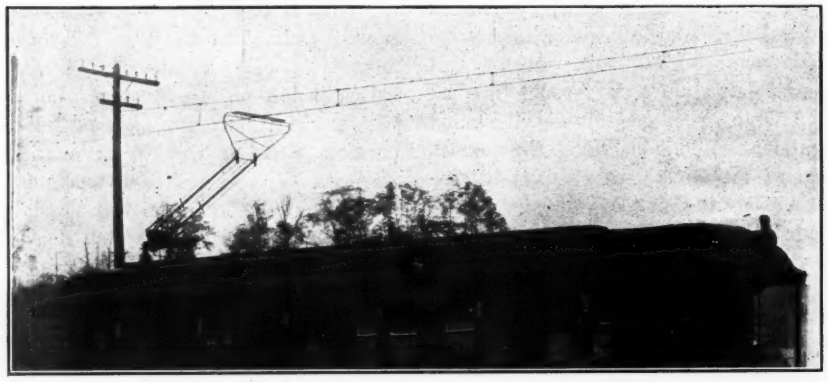


FIG. 10.—BOW TROLLEY MOUNTED FOR SERVICE.

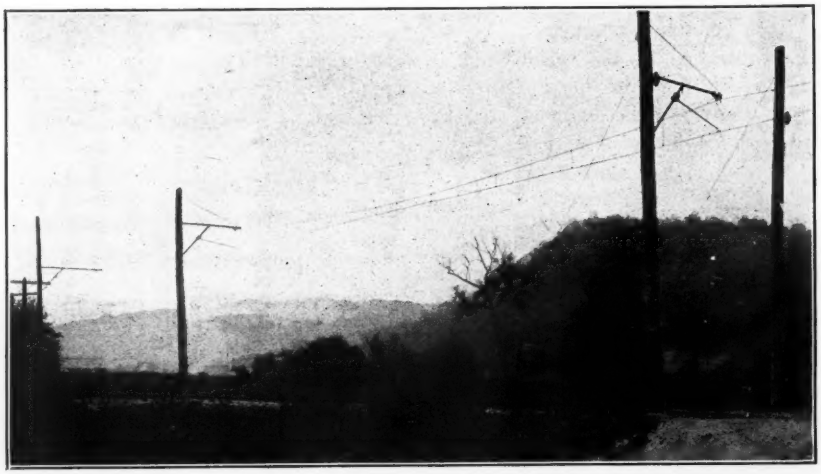


FIG. 11.—CATENARY TROLLEY LINE ON INTERWORKS RAILWAY.

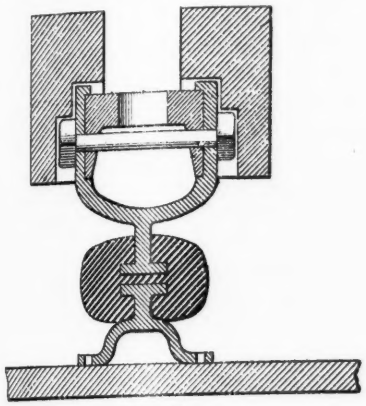
At each support, the trolley wire is attached at a point alternately twelve inches to right and left of the centre of the track, so that it is staggered, and the contact between it and the trolley varies from one side to the other, and thus undue wear at any point is prevented.

The overhead structure, which is of the catenary type, is shown in the accompanying photograph, Fig. 11, showing drop spans upon the interworks railway. The trolley wire is suspended from a messenger cable by hangers of different lengths, so graduated that the wire is at all points parallel with the track, presenting the best possible condition for continuous contact under high speeds. This construction also gives a greater rigidity, with the absence of up-and-down or sidewise motion, an increased strength and consequent ability to support loads of ice in winter storms; and strength and simplicity in all parts that minimize repairs and, in general, an efficiency in keeping with other portions of the system. The catenary structure can be suspended from side brackets as shown, or the ordinary span construction can be adopted. Grooved trolley wire is used, and since it is supported at frequent intervals, great rigidity can be obtained with a small size of wire. Suitable details of construction for use upon curves of different radius, of anchors, steady strains, section breaks, turn-outs, etc., have also been carefully designed.

A study of the system, as briefly outlined, has shown a consistency in theory and design which has been followed throughout the different pieces of apparatus, and which produces a high degree of efficiency and general harmony. The completeness with which all details have already worked out, together with the saving in both initial cost and expense of operation and maintenance, makes it highly practical, the company feels, for high-speed interurban traction. The field for development is a wide one. The way is also opened for the adoption of the system in city service, where perfect control, in conjunction with economical consumption of energy in starting, is of particular value, and for its use also in heavy units, such as are now confined to steam railroads, so that the development of this system may be regarded as a step toward the anticipated substitution of electricity for steam.

Electrical Patents.

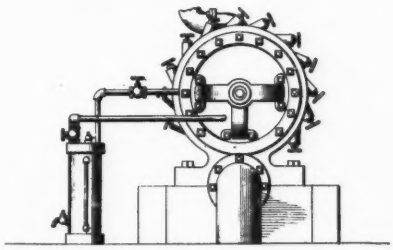
In the construction of rack-rail systems wherein the rack performs the double function of a traction rack and an electrical conductor, it is important to pro-



RACK RAIL.

vide means whereby the rack is efficiently insulated to enable it to perform its function of a conductor, while at the same time it is necessary to so mount and arrange the same and the insulation thereof as not to interfere with the operation thereof as a traction rack or the engagement therewith of a traction gear or sprocket carried by the locomotive and driven in a well-known manner. It is also important to provide against the accumulation of dirt or the like upon the rack, which might otherwise interfere with proper electrical connection between the rack and traction gear which engages with it or with the function of the rack as a conductor. It is also necessary to solidly anchor the rack as well against strains which are longitudinal as those which are lateral. It is also desirable to mount the rack so as to prevent accidental contact therewith. Elmer A. Sperry, of Cleveland, Ohio, has patented a rail (772,971, October 25) having these features, and has assigned the patent to the Morgan Electric Manufacturing Company, of East Chicago, Ind. In carrying out the invention, the combined conductor and traction-rack is made in sections arranged end to end. Each of these sections has lateral flanges forming flanking portions, and a connecting-web. Insulating stringers are applied against the exterior surfaces of these flanking portions and between the portions connectors are applied to secure mechanical and electrical continuity of the rack.

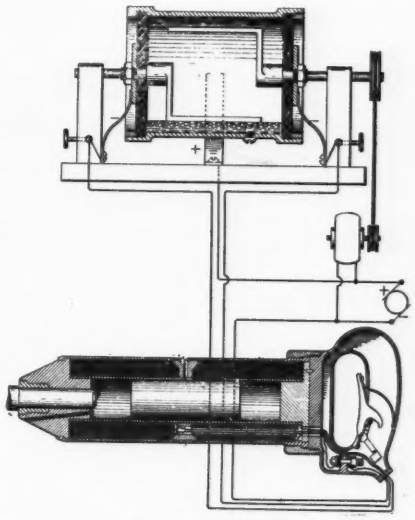
Louis E. Murphy, an engineer in the city electric light plant of Jacksonville, Fla., is the inventor of a lubricant conserver (772,954, October 23), the object of which is to prevent the loss of oil in rotary motor bearings, and its consequent deleterious influence on the boilers if the discharge is mingled with the feed water, by preserving and collecting the oil so that it may be used again. The motor employed in carrying out the invention is the De Laval steam turbine, comprising a suitable wheel case, within which a turbine wheel is mounted, supported by a sectional shaft, which is journaled in suitable bearings forming parts of the casing. Within the casing and on the other sides of the bearings are formed oil-receiving pockets, located beneath the shaft and arranged to receive the lubricant which may pass through the bearings, travel along and drip from the shaft. When these pockets are filled, the oil ordinarily passes through to the interior of the wheel case and eventually finds its way to the condenser and back to the boiler with the feed water. This objection is obviated by the following structure: a closed lubricant-receiving reservoir, consisting of a tubular shell having end caps, is located exteriorly of the turbine and has communication with the pockets through conduits or oil pipes leading from the pockets to a common coupling connected with the top of the reservior. In this coupling is arranged a suitable valve by



LUBRICANT CONSERVER.

means of which the communication is controlled. A pressure pipe, entirely independent of the first-mentioned pipes, constitutes the means of communication between the interior of the wheel case and the reservoir, this pipe being also provided with a controlling valve. A draw-off cock communicates with the lower portion of the reservoir and a valved vent is located in the top of the same. A gauge glass is employed which is secured to the side of the reservior. As long as the motor is running, the valves are open, while the vent and drawing-off cocks are closed. The result is that the vacuum in the motor and in the reservoir is equal and oil that may drip into the pockets will pass freely and without interference through the conduits into the reservoir. Thus it will be prevented from entering the wheel case and being passed to the boiler with the feed water. When it is desired to draw off the accumulated oil from the reservoir, the valves are closed, while the vent and draw-off cocks are opened, permitting the passage of oil through the latter.

An electric motor system has been devised and patented (773,120, October 25) by Adolph F. Christmas, of Pittsburg,



ELECTRIC MOTOR.

Pa., and a two-thirds interest in the patent obtained thereon has been assigned to Frank R. McFeatters, of Wilkinsburg, Pa. The object of the invention is to provide a system wherein a reciprocating motor having two coils may be employed and whereby the circuit will be broken and made momentarily and alternately through the two coils, so that heating of the motor is avoided and a high efficiency developed. The system consists of a reciprocating motor provided with two coils, a source of energy and a rotary circuit-breaker. The latter comprises a chamber partially filled with mercury, a main connects the positive brush of the source of energy with the mercury. Two oppositely arranged contacts cooperate with the mercury and are arranged during the rotation of the body to alternately contact with the mercury. Connections are made between each of the contacts and one of the coils of the motor, and a main from the coils is connected to the negative pole of the source of energy. A motor is bridged across the main and connections are made between the motor and the rotary circuit-breaker.

In 1903 the production of asbestos in the United States was 874 tons, compared with 1,005 tons in 1902. Most of the asbestos came from Sall mountain, in White County, Georgia.

Reviews of Current Engineering and Scientific Literature.

Single-Phase Commutator Motors.

This is the first section of what promises to be a complete study of the different types of single-phase commutator motors. Mr. F. Neithammer first gives a brief historical review of the performance of the earliest types of alternating-current commutator motor. Between the years 1880 and 1890 various attempts were made, but the development of the induction motors caused this field to be abandoned. A new epoch was opened when Heyland made use of a commutator for improving the operation of induction motors. Others have worked along the same line, notably Leblanc, Boucherot and Latour. The commutator has also been used to regulate the varying speed of induction motors and for starting simple induction motors by a repulsion or direct series effect. Among the types of single-phase commutator motors now recognized are the straight series motor, the repulsion motor, the compensated commutator motor, the transformer motors and combinations of these types. The single-phase shunt motor has never been used to any extent. The same is true of the three-phase commutator motor, though the latter deserves to be considered seriously. The performance of these motors is discussed by means of a vector diagram, which covers the theory of all types of single-phase commutator motors. By modifications of this diagram it is made to apply to any particular type. From this diagram it is shown how the various reactions may be modified by changing the form of the field or the method of winding. To secure a high power-factor, the leakage fields must be considered. This may be done by winding many shallow slots and choosing short armatures. The cross-magnetization is smallest for definite poles, especially if these be split, and may be neutralized by an auxiliary winding in the pole shoes. The series motor shows a good power-factor if wound with many armatures and few field turns. The normal speed of the series motor is usually nearly double synchronous speed. The torque of the single-phase motors is oscillatory—an unfortunate quality for railway work. The repulsion motor differs from the straight series motor in possessing an elliptical rotor field. It operates best at synchronism, even for high frequencies. Methods of controlling sparking are considered. When a commutator is used on a polyphase motor no trouble on this score is met.—*Abstracted from the Electrical Magazine (London), October 15.*

Worm Reduction in Electric Tramway Equipments.

Although the worm-reduction gear was used for tramway work in early attempts to apply electric motors to this service, it was not found satisfactory. In this article Mr. O. F. Domon considers this form of gear and attempts to show that, if properly constructed and installed, it should be satisfactory. An equipment of this kind has recently been tried by the Oerlikon Company on the Seebach-Oerlikon-Zurich electric tramway, in order that an exhaustive test might be made. It is thought that the advantage in wear and tear will be on the side of the worm gear, as compared with the spur gear, and that the former runs much more smoothly and without noise and the hammer blows caused by heavy motors. Further, the transition from one speed to another with the same controllers is smoother with a worm gear than a spur gear, and the former allows a lighter and higher-speed motor to be used. Energy consumption tests have shown that there is practically no difference between the two systems. The greater efficiency of the higher-speed motor makes up for the smaller efficiency of the worm wear as compared with the spur gear. When the car is running down grade by its own weight, the backward efficiency of the worm is less than that of the spur gear, as is shown by the fact that the worm car will only start on a grade of one in 100, while the spur-reduction car will start on a grade of three-quarters in 100, the car weights being equal. This point is of secondary importance, except when regenerative principles are contemplated. The main features of the new equipment are an improved worm gear with ball thrust bearings, a flexible and insulated connection between the worm and motor shafts, the insulation of the motor itself, and the position of the motor at the side of the truck, which makes it accessible from the side without the use of pits. The power transmitted to the tire is about twenty horse-power when the motor is running at 1,200 revolutions per minute, and the speed of the car is nine and one-half miles an hour. The worm has a right-hand, treble thread, and the reduction is one to twelve. The worm wheel runs in oil and the motor is not only insulated from the reduction gear, but from the frame of the truck.—*Abstracted from the Electrical Review (London), October 21.*

Lots Road Generating Station of the Underground Electric Railways Company of London, England.

This station, now nearing completion, will be the largest of its kind in Great Britain. Work was commenced on it two years ago. It will supply electrical energy to the entire District Railway, to the Great Northern, Piccadilly & Brompton, the Baker Street & Waterloo, the Charing Cross, Euston & Hampstead, the Hampstead & Edgeware and Edgeware & Watford roads. The station is on Lots road, Chelsea, between Chelsea creek and the Thames. Coal may be supplied either by rail or by water. There is storage room in the bins for 15,000 tons of coal. The daily consumption will be about 800 tons. The boiler equipment consists of eighty Babcock & Wilcox boilers equipped with chain-grate stokers and superheaters. Sixty-four of these are already in position, arranged eight boilers to a battery. There are two floors in the boiler room. Each set of boilers supplies steam to one Westinghouse-Parsons four-stage, parallel-flow steam turbine, coupled directly to a three-phase, 5,500-kilowatt generator with an overload rating of fifty per cent for two hours. When running at the normal speed of 1,000 revolutions per minute, these machines generate 7,000 volts at a frequency of thirty-three and one-third cycles per second. Each turbine is supplied with vertical surface condensers placed below the floor. There are four 125-kilowatt, 125-volt, continuous-current dynamos driven by reciprocating engines which furnish the exciting current. The main generators are star-wound, the neutral point being connected to earth through a resistance which limits the current through that circuit to 1,000 amperes. The switchboard is of the remote-control type and occupies three galleries running the entire length of the engine room—454 feet. In the first gallery are placed the motor-operated oil switches. In the second gallery are the main bus-bars, placed in separate

brick compartments. In the third gallery are the feeder bus-bars, extending the length of the engine room and also housed in brick compartments. The feeder control board consists of eighteen panels, seventeen of which are equipped with feeder instruments and switches. The remaining one is set apart for the control battery. For controlling the electrically operated auxiliaries, there is an auxiliary board. The feeders leave the station in a conduit which consists of sixty-four pipes, embedded in concrete. These are arranged in two sets separated by a nine-inch brick wall.—*Abstracted from the Electrician (London), October 21.*

Modern Elevator Types and Elevator Practice.

In this article Mr. Howard S. Knowlton points out the intimate part which the elevator plays in the movement of modern city life, and he gives a practical study of the various types, their characteristics and limitations. The requirements of elevator service are much more severe than those of railway operation. The car runs up a 100-per-cent grade with almost continuous service for long periods of time, and it must be accelerated from a standstill to a speed of 800 feet per minute in a little over a second and a half without discomfort to the passengers. This is an acceleration of five and one-half miles per hour per second—an acceleration impracticable on any railway. In comparing the relative merits of hydraulic and electric elevators, the availability of electric power from a central station must be considered. Advocates of the hydraulic machine hold that for light loads and comparatively slow speeds the simple motor-driven elevator is very satisfactory and economical, but when speeds of from 350 to 800 feet per minute are reached, serious complication is inevitable in the controlling machinery. Purely electric elevators are almost always of the drum type, driven by a motor through a single and double worm gear. The screw type, introduced eight years ago, has disappeared. Safety is a prime requisite in every kind of elevator service. One advantage in certain types of electric elevators is the ease with which the driving apparatus may be installed at the top of a hatchway, thus saving much valuable space. The relative cost of running the two types of machines varies with local conditions. If the quantity of water to be pumped is sufficient to warrant high-duty pumping engines, the cost of pumping the water is less than current can possibly be sold for, but where ordinary duplex pumps are used the electric cost generally runs lower. The elevator problem is not so much the movement of heavy loads at high speeds as a problem of control—that is, the rapid starting and stopping of these loads without unpleasant sensations to the passengers. With the hydraulic elevator this is easily accomplished by means of a valve. In electric elevators complications must be introduced, which require careful adjustment and are subject to disarrangement. In these respects the hydraulic elevators are characterized by simplicity and reliability. A hydraulic elevator which has come into recent use in office buildings is the plunger type, consisting of a cylinder set vertically in the ground directly under the car. When the running of the car exceeds twenty-five feet, a counterbalance is added. This type of elevator is particularly safe. It is impossible for it to fall, and it can not attain a downward speed that is unsafe.—*Abstracted from the Engineering Magazine (New York), November.*

The Australian Telegraph System.

The Australian telegraph system is owned by the people of Australia, and is managed as a part of the postal system of the country. This arrangement came about because when telegraphs were first constructed no private companies would have taken the risk, and as the choice lay between telegraphs constructed and managed by the government and no telegraphs at all, a system of government ownership was adopted. The results of this arrangement are here discussed by Mr. Hugh H. Lusk, and the showing is surprising. Australia is a wealthy country, and there is a tendency to be lavish in matters of public expenditure. The telegraph lines were extended into districts where the demand was small and the population scanty. The result has been that here, more than any other country, there is a chance for investigating the effect which may be expected to follow from the public ownership of a great public convenience. When the separate colonies of Australia were formed into states, and these federated into a commonwealth, the post-office system took over the telegraph. This resulted in establishing uniform rates throughout the commonwealth on a scale that was liberal to the users and fair to the revenue. Australia is settled only along the southern coast and partially on the eastern and western coasts. This condition has made the telegraph lines very long, and the necessity of keeping in contact with settled points at times has made the length of the telegraph line double that of a direct line. The length of lines now owned by the government is 48,000 miles, and the length of wires is more than 100,000 miles. This mileage is greater than that of any European country, except Russia, Germany and France, while, in proportion to the number of inhabitants, it is nearly six times as great as that of any country except New Zealand. There are about 3,000 telegraph stations kept open for the convenience of a population which does not exceed 4,000,000. The rates charged are: for suburban messages not exceeding sixteen words, including address and signature, twelve cents; for messages to a point within the same state, eighteen cents, and for messages to any other state in the commonwealth, twenty-four cents. Delivery is made within a radius of one mile from the receiving office without extra charge. Comparing this with conditions in this country, we see that this population of 4,000,000, scattered along a coastal belt 5,000 miles in length, with widely separated centres of population, enjoys the most modern facilities of communication to an extent far greater than in proportion to their numbers at less than half the cost at which the same facilities are supplied to a population nearly twenty times as great, and far less widely separated. The reasons for this are three: first, the government can borrow the working capital at a lower rate of interest than a private company; second, the cost of maintaining the lines in good order when constructed is small, since the whole system is controlled by one management; and, third, the working expenses are low because the telegraph office is placed in the post office. No separate quarters are necessary, and except in large cities no additional help is needed. The secret of the success of the Australian system is not only that it is economically conducted, not only that it is not loaded with heavy interest and big dividends, but because it is appreciated and made use of by the people. Thus, in the United States the number of telegraph messages per year averages one per inhabitant. In Australia the average is two and one-half messages per inhabitant. This, of course, refers only to the whites.—*Abstracted from the North American Review (New York), November.*

Telephone and Telegraph Service in Reporting Election Returns.

As usual, the telegraph and telephone interests of the United States made special arrangements for reporting the election returns on the evening of November 8. So complete and so carefully managed were the facilities that an extraordinarily large vote was reported very early in the evening. Among the companies which performed an excellent election service were the American Telephone and Telegraph Company, the New York Telephone Company, and the New York & New Jersey Telephone Company.

The American Telephone and Telegraph Company, under the direction of Mr. C. H. Wilson, general superintendent, handled all long-distance traffic without a hitch. Mr. Wilson received the congratulations of national and state department officials at Washington, and from the newspapers all over the country for the early and accurate returns.

The New York Telephone Company, under the direction of Mr. U. N. Bethell, first vice-president and general manager, instituted a local service which, for extent and completeness of area covered, exceeds everything heretofore attempted.

In Brooklyn the New York & New Jersey Telephone Company tendered a number of prominent persons a reception at its headquarters, 81 Willoughby street. A complete local and long-distance service was carried out under the direction of Mr. W. D. Sargent, vice-president, and Mr. John C. Reilly, general manager of the company.

During the evening a collation was served, and the guests present enjoyed the hospitality of the local company to the highest degree.

The Iron and Steel Institute Entertained by the Westinghouse Electric and Manufacturing Company.

On Wednesday, November 2, the Westinghouse Electric and Manufacturing Company entertained the members of the Iron and Steel Institute, of Great Britain, at its works in Pittsburg, Pa. The members of the institute were shown through the various works during the afternoon, and were tendered a banquet in the evening.

The banquet was given in the largest aisle of the works of the Westinghouse Electric and Manufacturing Company, the length of this aisle being about one-third of a mile.

The portion of the aisle set apart for the banquet was decorated with flags of the United States and Great Britain, and the floral decorations were of great beauty and magnitude. The lighting effects were remarkable. Bremer lamps were strung from the ceiling, and Cooper Hewitt lamps were suspended from the sides, this latter effect making possible the taking of a number of photographs.

A lounging room was provided for the convenience of the guests, where writing materials and souvenir postal cards showing the interior and exterior views of the works were provided. A souvenir in the form of a miniature induction motor was presented to each guest.

Sir James Kitson, past-president of the British Iron and Steel Institute, thanked the city of Pittsburg, on behalf of Andrew Carnegie, for the kindness shown to the visiting manufacturers.

Mr. George Westinghouse responded briefly, stating his great pleasure in being honored by the presence of so many distinguished visitors from abroad.

The Lewis and Clark Centennial Exposition.

The Lewis and Clark Centennial Exposition will be held in Portland, Ore., opening June 1, 1905, and closing October 15, 1905. The exposition grounds cover a space of 407 acres, and include a beautiful natural lake. The United States government has appropriated for its buildings and exhibits $475,000, and the Oregon state legislature has appropriated $500,000. The citizens of Portland, Ore., have subscribed and paid in $500,000.

The approximate cost of the whole exposition is $5,000,000. There will be over ten large buildings for exhibit purposes. No charge will be made to bona fide exhibitors. Electricity, steam, gas and water will be furnished at reasonable rates.

Awards will be given to exhibitors on recommendation of an international jury on the merit of exhibited articles. Practically all of the states in the Union and the representatives of foreign governments have enrolled for extensive exhibits.

The Lewis and Clark Centennial Exposition will celebrate the one-hundredth anniversary of the exploration and annexation of the "Oregon country," now comprising the states of Oregon, Washington, Idaho and a large portion of Montana and Wyoming.

Henry E. Dusch is director of exhibits, Oregon Building, World's Fair, St. Louis, Mo. The allotment of space commenced on November 1, 1904.

In a paper read before the Bunsen Society, at Bonn, Professor Nernst discusses the fact that it is possible to pass through the body, without the least discomfort, Tesla currents at a strength which at a lower frequency would certainly cause death. According to Professor Nernst, the explanation lies in the fact that the current never lasts sufficiently long in one direction to alter the concentration of the contents of the cell. He holds that changes in concentration vary directly with the strength of the current, and inversely as the square root of the frequency. He has confirmed this hypothesis by an experiment on a frog submitted to a current, the frequency of which could be varied 100 and 200 cycles per second.

International Electrical Exposition.

An electrical exposition will be held at Madison Square Garden, New York city, December 19-28 inclusive. It is expected that this will be the largest and most interesting of its kind ever held in New York. The exposition is to be held under the patronage of the Electrical Contractors' Association, of New York city. The association is a member of the Building Trades Employers' Association. The association has appointed a committee to act in conjunction with the exposition management, the chairman of the Contractors' association being James R. Strong. Acting with him are J. P. Hall, S. Davis, L. K. Comstock, J. C. Hatzel and George W. Russell, Jr.

Mr. L. Lawrence Weber and Mr. E. F. Rush, whose offices are in the Knickerbocker Theatre Building, Broadway, have the exposition in charge.

Trolley Cars on the Williamsburg Bridge.

Trolley cars commenced running over the new Williamsburg bridge, New York city, on November 4. Cars of seven lines of the Brooklyn Rapid Transit Company, and of two lines of the Coney Island & Brooklyn Railroad Company, cross the bridge, as well as three "bridge locals," which run only between the plazas at each end of the bridge. The cars run on a headway of about one every minute, and consume seven or eight minutes in crossing the bridge. The bridge locals are run on a headway of about seven minutes, but this service is soon to be increased.

Many persons who formerly crossed the Brooklyn bridge made use of the new service. Each car carried about sixty-five passengers during the rush hours.

The Transactions of the National Electric Light Association.

The transactions of the National Electric Light Association, consisting of the literature of the twenty-seventh convention of the association, held at Boston, Mass., May 24, 25 and 26, 1904, are contained this year in two volumes. Vol. i comprises papers, reports and discussions; vol. ii comprises the question box and "wrinkles." The frontispiece is an excellent portrait of Mr. Charles L. Edgar. The question box and "wrinkles," assuming such proportions as to require a separate volume, show the importance of this feature of convention work. The books have been well printed on good paper, and are substantially bound. They comprise a most valuable addition to the literature of the subject.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Ticket Office and Toilet Room Heaters for the New York Subway.

For heating of the ticket offices of the New York Subway the engineers of the Interborough Rapid Transit Company de-

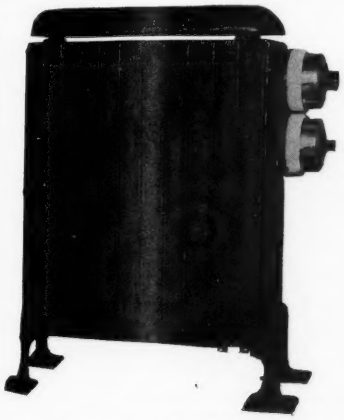


FIG. 1.—EXTERIOR VIEW OF ELECTRICAL HEATER.

cided, after a thorough test of heaters representing the various systems of electric heating, to adopt the special heater submitted for their consideration by the Prometheus Electric Company, of New York, which is shown in Figs. 1 and 2.

The heater consists essentially of a cast-iron box supported on two sets of legs, the box being sixteen inches wide, seventeen inches high by four and one-half

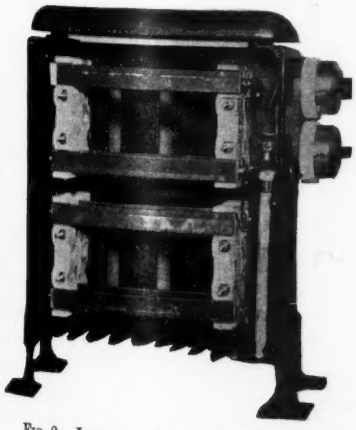


FIG. 2.—INTERIOR ARRANGEMENT OF ELECTRICAL HEATER.

inches deep. As will be seen in Fig. 2, the air is admitted through the bottom of the heater, which contains a number of openings and escapes, after being heated, through an opening at the top of the heater, which is covered by an iron canopy, leaving an air space of one inch between the box and the canopy. To prevent any possible overheating of the box, which might cause scorching of clothing, a number of slots are provided on the back of the heater to facilitate the escape of heated air.

Two 500-volt ten-ampere switches are mounted on a special support at one end of the heater and by means of these switches one-half or the full heater equipment of each heater may be used.

A ribbed plate is attached to the front of the heater by means of screws, and by simply taking off this plate the interior of the heater may be inspected, as shown in Fig. 2.

The electric equipment proper consists of eight iron-clad Prometheus heating units supported on blocks of porcelain, which are attached by means of studs to the back of the box.

The main circuit wires leading to the heater are passed through a special

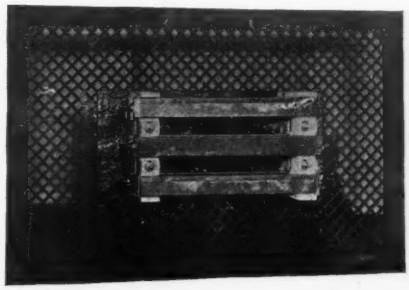


FIG. 3.—REAR VIEW OF VENTILATED ELECTRIC HEATER.

porcelain bushing and a porcelain tube at the one end of the heater, as shown, where they are connected to copper lugs.

The Prometheus units each have a capacity of 100 watts, so that the total capacity of the heater is 800 watts. Each unit is one and one-quarter inches wide by twelve inches long by one-eighth-inch thick.

The heaters which have been adopted for use in the toilet rooms are shown in Fig. 3, illustrating the back of the heater. These wall plates, which measure fourteen inches by twenty-eight inches and which are finished in dull nickel, are to be attached to cast-iron boxes, which are built into the wall, in such a manner that after the heater is in place the front of it is flush with the slate covering of the walls.

The electrical construction of these heaters is similar to that of the ticket office heaters, the same parts being used for both types of heaters. A number of these wall heaters are equipped with six iron-clad units, giving a total capacity of 600 watts, and another set of plates is equipped with four units making a total capacity of 400 watts. There are four of these heaters in each toilet room and they are controlled by switches in such manner that the heaters may be turned on and off in sets of two or one-half of each heater may be used at any one time in conjunction with one-half of any other heater.

The plate being of the grid pattern, permits of a thorough circulation of the air, preventing overheating of the plate.

The Marshall Pull Socket.

In the issue of the ELECTRICAL REVIEW for October 29, on page 724, a description was given of the Marshall pull socket. The cap is exactly like that of an ordinary socket, and the shell is varied from the standard by having a metal bell attached to one side, in place of the slot for the key. The chain pull is radial, and there is no grating sensation from the chain rubbing through the bell. In the issue mentioned it was stated that the chain was insulated from the mechanism by a short piece of woven linen Tuna lining. The word "lining" was incorrect, and should have been "line." This line stands a strain of over thirty-five pounds. The company states that this socket will stand from five to six times the turning of an ordinary key socket.

India-Rubber and Gutta-Percha Insulating Company.

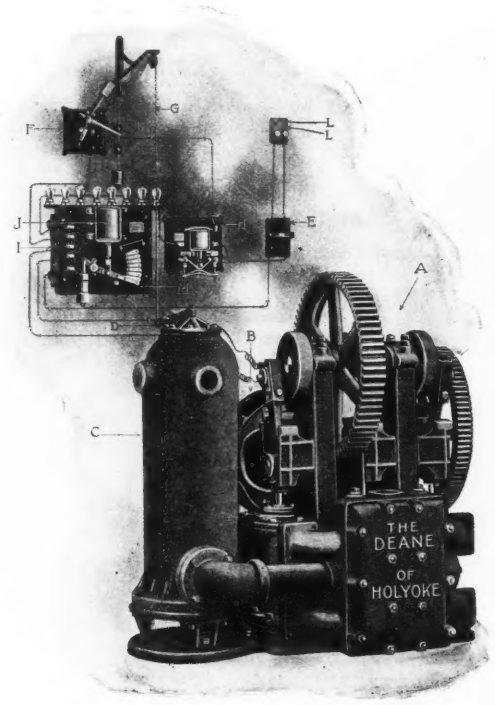
At a meeting of the board of directors of the India-Rubber and Gutta-Percha Insulating Company, Yonkers, N. Y., held October 19, 1904, a dividend of two and one-half per cent on the capital stock was declared. This was payable November 1. The India-Rubber and Gutta-Percha Insulating Company possesses excellent facilities for the manufacture and prompt shipment of insulated wires and cables, and under the able direction of Dr. W. M. Habirshaw, president and general manager, is supplying a constantly increasing demand. The company is pointing with much pride to the notable list of modern buildings, both for residential and office purposes, which have been wired entirely with its insulated wires and cables.

Automatic Motor-Driven Boiler Feed-Pump and Receiver.

The International Steam Pump Company, New York city, has introduced a motor-driven triplex boiler feed-pump and receiver, with automatic switches and motor starter for automatically draining heating systems and factory apparatus which depend upon the free circulation of steam for their efficiency. It automatically relieves a heating system of the water of condensation, and thus ensures a free and unobstructed circulation, and incidentally prevents water hammer in the piping. It also automatically delivers this water directly to the boilers without the intervention of tanks or other devices.

In the cut, A is the pump; B, the motor; C, the receiver, and D a lever operated by a pail float within the receiver, which rises and falls as the water level changes. E is the main-line switch, which operates by hand to cut out the line when necessary. F is a switch operated by the float in the receiver through a chain and counterweight G. H is the automatic switch which admits current to the motor starter I when the switch F is thrown in by action of the float. I is the motor starter, which delivers current gradually to the motor, and is operated by the solenoid J. K is the fuse block and L the line wires.

The switch E being closed, water rises in the receiver and throws in the float switch F, turning the current through the automatic switch H and the solenoid J, thus gradually pulling the lever I, which starts the pump. As the water is pumped out the float falls and the operation is reversed, stopping the pump. The arrangement is the same whether the pump be either single-acting or double-acting. The receiver and the pump are mounted on the same base, so that the apparatus is compact and self-contained. The suction pump is connected to the bottom of the receiver, and the water of condensation flows into the receiver through inlets near the top. The receiver float consists of a pail open at the top, and hung from a lever having a counterweight so placed as to balance the weight of the pail. The pail is kept filled with water, and when the receiver is empty the weight of this water causes the pail to hang in its lowest position. As soon as the water rises in the receiver above the pail, the weight of the float is immediately reduced to the weight of the pail, and the counterweight causes the pail to rise to its highest position and to throw the float switch F and start the pump. The float is so guided as to hang in the centre of the receiver without swinging, and the receiver inlets are provided with hoods to prevent the entering water interfering with the action of the float.



AUTOMATIC WATER-DRIVEN BOILER FEED-PUMP AND RECEIVER.

Single-Phase Induction Motors.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., has placed upon the market a single-phase, alternating-current motor, which is shown in the accompanying illustrations. Fig. 1 shows the standard five-horse-power, self-starting motor, and Fig. 3 shows the stator and rotor of the same motor. The company uses a winding in the field similar to that of a polyphase induction motor, and connects a condenser shown in Fig. 2, between a point in this winding and one of the two main terminals of the motor. The current in a part of the winding is displaced in phase with relation to that of the main line by reason of the capacity effect of the condenser. As a result of this a good starting torque is developed. With this arrangement the required starting torque is supplied without any commutator or other objectionable feature. Also, the condenser is connected into the circuit at all times, and since it neutralizes the lagging current in the motor, the result is a power-factor at the main terminals of the motor which in the larger sizes is practically equal to 100 per cent for wide variations of load.

The armatures are so wound that a starting resistance can be inserted in any armature in series with the conductors.

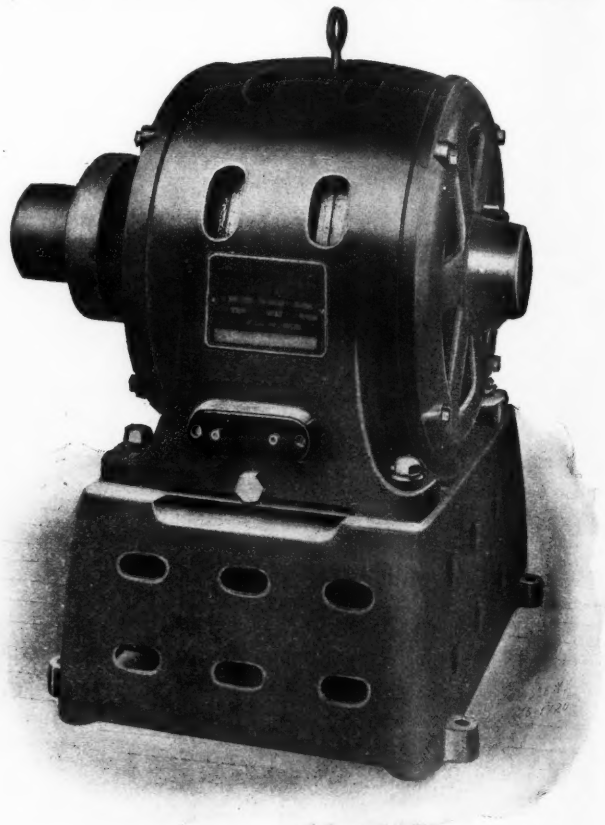


FIG. 1.—FIVE-HORSE-POWER, SELF-STARTING, SINGLE-PHASE INDUCTION MOTOR.

In this way the starting current is made to keep below the full-load value. This starting resistance enclosed in the armature is short-circuited after the motor has nearly reached full speed by means of a very simple type of switch operating automatically by centrifugal force. Each motor is also supplied with a combined pulley and friction clutch. When the armature stands at rest this clutch is released, so that when the motor is started the rim of the pulley and, therefore, the belt remain at rest. When the armature has nearly reached full speed, centrifugal force acting on weights on the clutch automatically causes a steel ring to expand and to press on the outside of the pulley ring, with the result that the pulley is gradually brought up to full speed. As this operation takes place after the armature reaches full speed, the current taken by the motor to actually start the load is only in proportion to that load. The only operation required to start the motor is to close the main switch. In case the power is off the line at any time, the motor will start automatically without delay as soon as the power returns.

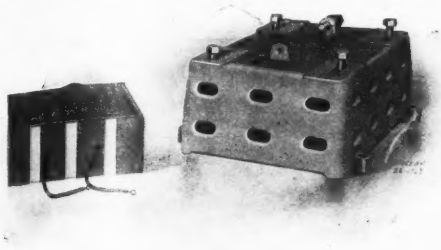


Fig. 2.—Condenser for Self-Starting Motor.

These motors can not run away when the load is suddenly removed, and in this respect resemble the polyphase induction motors. This is the standard type of single-phase motor built by this company.

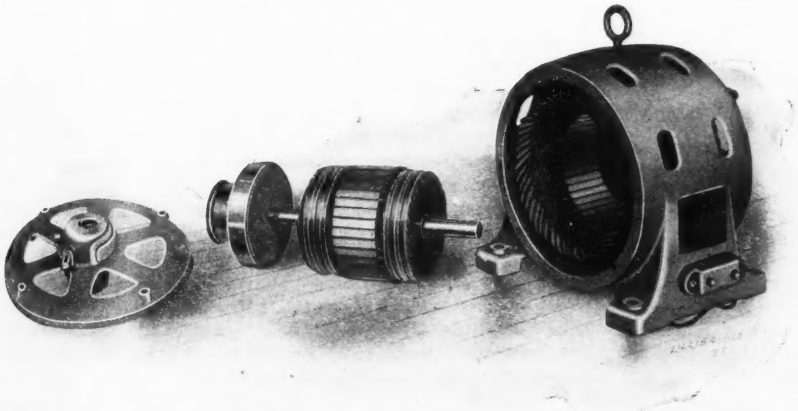


Fig. 3.—Stator and Rotor of Self-Starting, Single-Phase Motor.

Fig. 4.—One-Quarter Horse-Power Hand-Starting, Single-Phase Motor.

In the smaller sizes it also builds a hand-starting motor, which is shown in Fig. 4. The frames of both types of motors are so shaped as to almost entirely enclose the motor. They are cast with openings of such sizes and in such positions that air is drawn in at certain places, and, by means of the rotary motion of the armature, is thoroughly circulated around the various parts where heat is developed, and then expelled through other openings. The maximum rise of temperature does not exceed forty degrees centigrade under full load. The condensers are sealed in air-tight cases to protect them from moisture and injury, and the motor terminals are designed so that, when the motor is properly installed, they are protected and it is impossible for any one to touch any metal connected with the circuit or to receive a shock in any way.

According to the *Electrical Magazine* (London, England), M. Gabran has recently published the results of experiments undertaken with a view of obtaining rapid deposits of zinc. The best electrolyte for this purpose he found to be as follows: zinc sulphate, 1,200 parts; sulphuric acid, 24B, sixty parts; water, 6,000 parts. Using current densities of two and three amperes per square decimetre, very clear deposits were obtained with this liquid, the tension being kept between 1.5 and 2.5 volts. Subsequently this density was increased to six amperes per square decimetre, and the voltage to nine or ten. This did not in any way influence the deposit, although crystals of zinc formed on the edges of the cathode. When employing greater current densities the electrolyte must be kept rapidly circulating. For galvanizing large pieces of work, such as plate receivers, hulls of ships, etc., M. Gabran has devised an apparatus consisting of a large cup-shaped lead receiver with rubber-protected edges, in and out of which the electrolyte is conveyed through piping. The anodes are constituted by zinc cylinders fixed to the bottom of the receiver, which is connected to the positive pole. In use the apparatus is pressed hard against the plate or article to be galvanized, which thus acts as a cover. The electrolyte is prevented from escaping by a rubber ring. With a current density of eighty amperes per square decimetre and a pressure of thirty volts, a surface 0.8 decimetre in area can be coated in this way with zinc in about seven seconds. According to the inventor, the apparatus is to be used for galvanizing rivets in hulls whose plates have previously been galvanized.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

A MUNICIPAL ELECTRIC PLANT FOR SOUTH AFRICA—The city council of Kalk Bay Station, Cape Colony, South Africa, has been empowered to issue bonds for such an amount as it may need to erect a municipal electric light and power plant.

SOUTH CAROLINA CAPITAL TO ESTABLISH A LARGE POWER PLANT—The Broad River Light and Power Company has been incorporated at Charleston, S. C., with a capital of $1,000,000. The incorporators are all residents of Charleston. It is expected that the site of the operations will be at Union, S. C. The incorporators are J. L. David, J. H. Dingle, W. G. Green, A. B. Kugler, J. L. Perry, D. V. Smith, F. K. Myers, E. W. Wynne, M. V. Haselden, M. R. Rivers, P. J. Balanger and J. M. Rivers.

TO ABSORB A NUMBER OF OHIO ELECTRICAL ENTERPRISES—A plan is being discussed looking to the formation of a company to absorb a number of electrical enterprises in Ohio. These enterprises include the Edison company, the Power company, and the Tiffin, Fostoria & Eastern Company, of Tiffin, Ohio. It is not proposed, however, to confine the consolidation of electrical interests to Tiffin, but an attempt will be made to secure the electric railway operating between Fostoria and Findlay, Ohio, as well.

UNITED ELECTRIC LIGHT AND POWER COMPANY TO BUILD NEW POWER-HOUSE—The United Electric Light and Power Company will build a new power-house, at a cost of about $1,000,000. A site of twenty-two acres has been purchased from the South Baltimore Company at Westport, Md. It is located between the tracks of the Western Maryland and the Baltimore & Ohio companies, and includes water frontage and a considerable area which can be filled in and reclaimed. A building 100 by 200 feet, of concrete, will be erected. At first there will be installed 13,000 horse-power, but the station will be planned to increase the capacity to 50,000 horse-power.

LARGE VIRGINIA RAILWAY COMPANY CHARTERED—The Virginia & Southeastern Railway Company has been chartered at Richmond, Va., by the state corporate commission. The capital is from $1,000,000 to $10,000,000. The road is to be built in Lee, Wise, Scott, Wythe, Tazewell and Giles counties, and is to run from the Tennessee line to some point on the Virginia & Southeastern railway. The company purposes developing what is said to be one of the richest coal fields in the Virginia district. The directors are Oliver H. Payne and G. B. Schley, of New York; Walter Ferguson and Henry K. McHarg, of Stamford, Ct.; John B. Newton, J. Bewley and D. B. Hull, Sr., of Bristol.

ST. LOUIS TRANSIT SYSTEM'S MERGER PLANS ENJOINED—A temporary injunction restraining Brown Brothers & Company, of New York, from establishing a merger of the St. Louis Transit Company and United Railways Company assets has been granted at St. Louis, Mo., by Judge Fisher, in the St. Louis Circuit Court, on application of attorneys for Louis A. Cella, S. W. Adler and C. A. Tilles, who assert the ownership of 11,000 shares of the St. Louis Transit Company's stock. The court was asked to set aside the reorganization of the two companies, on the allegation that the stockholders were induced to go into the merger through misrepresentation. It is also asserted that the assets of the companies are greatly in excess of the indebtedness.

TO REPORT SHIPS BY WIRELESS TELEGRAPHY—Communication has been established by wireless telegraphy between the torpedo station at Newport, R. I., and the government station on the lightship at Nantucket Shoals. The government is now ready to transmit over this line all messages for the press and public, subject to the condition that it will be in no way responsible for the collection of tolls, and with the understanding also that all government messages will have precedence. All passing steamers will be reported, and this news communicated to the telegraph office at Newport for transmission to the newspapers. The distance between the stations is ninety-five miles, and twelve words a minute can be sent. There are also stations at New Bedford, Mass., and Montauk Point, L. I.

LARGE CONTRACT FOR GENERAL ELECTRIC APPARATUS—What is believed to be one of the largest single contracts for electrical equipment ever obtained by American interests abroad has been awarded to the British Thomson-Houston Company, Limited, of Rugby, England, this company being controlled by the General Electric Company, Schenectady, N. Y. The contract, which is valued at about $7,000,000, is for the motor equipment to be used on the extensive underground and surface electric traction system now under construction in and around the British metropolis by the Underground Railways Company, of London, Limited. There will be 480 cars equipped with motors aggregating 500 horse-power per car. About 140 miles of line are being built by the Underground company. Power will be derived from a central station at Chelsea, located in the southwest section of London.

EXTENSIVE TRANSACTIONS IN NIAGARA POWER—It is stated that a transaction has been closed in Cleveland, Ohio, for the purchase of $1,000,000 of the forty-year, five-per-cent bonds of the Ontario Power Company, of Niagara Falls. This company was formed for the purpose of building a power station on the Canadian side of the Niagara river, at the foot of the cliff just below the Horseshoe falls. The plans of the company call for a station that will produce 180,000 horse-power, and one-third of the station is so nearly completed that it is expected it will be in operation early in the coming season. It is thought that the syndicate which has made this recent purchase will establish a transmission company in New York state for the distribution of power from the central station to all points on a traction system throughout the state, current being carried possibly as far east as Utica, and south to the Pennsylvania state line.

INDEPENDENT TELEPHONE COMPANY—Articles of incorporation are being drawn up for the Independent Telephone Securities Company, which is about to be organized and which will have headquarters at Utica, N. Y. The object of the proposed corporation is to purchase the stock and bonds of independent telephone companies and to hold a controlling interest in these companies, improving the service and strengthening the different local plants. The company will have a capital stock of $800,000 and an authorized bond issue of $15,000,000. Its home office will be in Utica, and the directors are Thomas W. Finucane, of Rochester; Frederick W. Zoller, of Rochester; George R. Fuller, of Rochester; Charles H. Poole and T. H. Ferris, of Utica. The company will have in its treasury securities amounting to $428,000, representing the control of the Utica Home Telephone Company, the County Telephone Company, of Herkimer, and the Otsego Home Telephone Company.

TO REORGANIZE THE SNOQUALMIE FALLS ELECTRIC COMPANIES—For some time the reorganization of the Snoqualmie Falls electric companies has been under way. These companies have been operating since last February as the Snoqualmie Falls & White River Power Company, distributing power at Seattle and Tacoma, Wash. The capital stock of the company will be increased from $3,000,000 to $3,500,000, and in addition it is probable that bonds will be issued for a large amount. The new company succeeding the Snoqualmie Falls & White River Power Company will be the Seattle-Tacoma Power Company. It will own the power plant at Snoqualmie Falls, as well as the properties in Seattle and Tacoma formerly operated under the names of the Seattle Cataract Company and the Tacoma Cataract Company, respectively. The White River Power Company, which is now building a large power plant with Lake Taps in Pierre County as the main reservoir, will continue as an independent corporation. The White River company is now engaged in heavy construction work and in surveying the watershed of the White river.

CONTRACT LET FOR A LONG-DISTANCE TROLLEY LINE—Contracts amounting to $1,000,000 have been awarded for an elec-

tric railway which is ultimately to connect Pittsburg with Indiana, Pa. The line will be known as the Pittsburg & Allegheny Valley Railroad Company. It was chartered at Harrisburg in 1902. The capital is now $1,200,000, and the officers, mostly from Pittsburg, are practically the same as those of the Meyersdale & Salisbury Street Railway Company, which is now in course of construction from Cumberland, Md., to Meyersdale, Pa. This road will extend eventually to Johnstown, Pa. The Pittsburg & Allegheny Valley road will run from Oakmont to Apollo, a distance of twenty-six miles, by private right of way, and by spring an extension will be built to Blairsville, where connection will be made with a new line now being built from Indiana to Blairsville, Latrobe and Derry. At Oakmont connection will be made with the Pittsburg Railways Company. It is the object of the new company to light a number of towns of the Allegheny and Kiskiminetas valleys. The company has already purchased the Apollo Electric Light Company and the Leechburg Electric Light Company. The president of the company is O. W. Kennedy, of Uniontown; W. W. Staub, of Bellevue, is assistant to the president; J. Q. Cochrane, of Apollo, is vice-president; J. D. Orr, of Leechburg, secretary, and W. J. Ward, of Pittsburg, treasurer.

MARYLAND TELEPHONE COMPANY TO ENGAGE IN ELECTRIC LIGHTING BUSINESS—It has been announced that arrangements have been made for the erection of an electric light and power plant to cost over $2,000,000, by the Maryland Telephone and Telegraph Company, Baltimore, Md. The company has secured a lot fronting on Gould street, and extending to the Patapsco river. The property comprises 6.4 acres, and by filling in to the wharf line, over three acres will be added to the area. It is stated that a contract has been executed for electrical apparatus and boiler machinery. The Baltimore Electric Power Company, which was recently incorporated with an authorized bond issue of $7,500,000, and a capital stock of $3,500,000, will ultimately take over the light and power business. The officers of the new company are D. E. Evans, president; R. F. Bonsall, treasurer; W. T. Spring, secretary. Pending the permanent organization, the directors of the company are H. W. Webb, D. E. Evans, John T. Stone, W. T. Burroughs, R. F. Bonsall, W. T. Spring and George R. Webb. The plant in its entirety has been designed on the separate unit plan. This will make the whole system virtually so many distinct power plants placed side by side. This arrangement will hold throughout the coal-handling apparatus, the boilers, steam piping, turbines, condensers, generators, switchboard, underground cable, etc. In addition to this precaution against interruption, the company will install a large storage battery.

ELECTRIC LIGHTING.

PHILADELPHIA, PA.—Electric light will be installed at Linfield.

MONTGOMERY, ALA.—D. P. West has been granted a permit for the erection of an electric light and ice plant.

CHARLES CITY, IOWA—A. L. Dodd and others seek a franchise for an electric light plant. Contracts will be let in the early spring.

JEFFERSON CITY, MO.—The special election to vote on the proposition of granting an electric light and gas franchise will be held November 15.

HARTFORD, KY.—J. W. Hale, of Fordsville, will shortly begin the installation of an electric light plant in Hartford. About 800 lights are to be put in.

DANBURY, CT.—The citizens of Westport are considering the question of purchasing the water and electric plant in that town. It is thought the deal can be made for about $145,000.

GEORGETOWN, ILL.—A. M. Searles, of Chicago, has made the town board a proposition in regard to installing a system which will furnish arc lights for municipal use and incandescents for private use.

OMAHA, NEB.—The city council of Omaha has adopted an ordinance for the submission of the question of issuing $500,000 for the construction, appropriation or purchase of conduits, and the installation of an electric lighting plant.

BAKER, ORE.—C. R. Aldrin states that arrangements have been completed for the construction, in the early spring, of a water-power plant at the Greenhorn with a capacity of 800 horse-power. This power will be supplied to mines which have already made application for it.

CHICAGO, ILL.—The Lagranse Service Company, of Chicago, has been incorporated with a capital of $100,000 for the purpose of buying the electric light and waterworks plant of the villages of Lagranse Park and Crossdale. Buell McKeever, George C. Madison and Henry J. Dunbough are the incorporators.

WICHITA, KAN.—Wichita is to have a new electric light and heating plant in the near future. At a meeting of the city council a franchise was granted to the Citizens' Electric Light, Heat and Power Company. The company states that the plant will be in operation before many months have elapsed.

PENN YAN, N. Y.—The walls of the new municipal electric plant at the waterworks pumping station, on the west shore of lake Keuka, are nearly completed. About 600 poles will be required to string the wires for street and residence lights. It is expected that the plant will be in working order by December 15.

FOSTORIA, MICH.—The question of organizing a company to put in an electric light plant here is being agitated, and is received with much favor. The proposition is to light the streets at night and stores and private residences. A committee has been appointed to ascertain the cost of a plant suitable to the needs of the village.

LINCOLN, NEB.—The Nebraska Electrical Company, of Omaha, has secured the contract for the poles, lines and wiring of the Lincoln municipal electric lighting plant. The bid was $33,260. The Wagner Electric Company, of Omaha, was awarded the incandescent lighting contract. The total cost of constructing the plant will be $82,000.

MUNCIE, IND.—The Muncie Electric Light Company has begun work on an extensive second power plant. The new building will be adjacent to the one in present use and will be 60 by 125 feet. It will be completed by December 1, according to the present plans, and will more than double the capacity of the present plant. The plant will be complete in every detail and modern in every way.

SALEM, ORE.—An ordinance has been passed making a new contract with the local electric light company for street lights. Under the old contract, which expired some time ago, the city paid $5.95 per light per month for thirty-five arc lights of 2,000 candle-power. Under the new contract, which is for five years, the price remains the same, but the number of lights is increased to sixty.

MILWAUKEE, WIS.—City Engineer Poetsch has contracted with R. G. Hunt & Company, of Chicago, to make an estimate as to the probable cost of the erection and maintenance of a municipal light plant, under a special resolution passed by the common council. The cost per lamp of 2,000 nominal candle-power also must be shown in the report, which probably will be ready within a few weeks.

LOCKPORT, N. Y.—The Niagara, Lockport & Ontario Power Canal Company has accepted the franchise given by the city of Lockport to use the streets of the city for electric lighting, heating and power purposes, the said electricity to be generated by the power canal from Niagara river to this city. It is rumored that the Niagara, Lockport & Ontario company has already taken several big contracts and has sublet them to the Ontario Power Company until it is in a position to take care of them.

NORFOLK, CT.—The Norfolk Electric Light and Power Company has been reorganized. The stock has been acquired by Francis R. Cooley, William R. C. Corson and Arthur D. Newton, of Hartford; Walter S. Morton, of New York, and J. Henry Roraback, of Canaan. Messrs. Morton, Newton and Roraback have been elected directors. The officers are: president, J. Henry Roraback; secretary, W. S. Morton; treasurer, Arthur D. Morton. The reorganization is a preliminary step toward a merger with the Berkshire Power Company. The consolidation will be effected as soon as the Berkshire concern has completed the erection of a dam and an electric power station on the Housatonic river, near the toll bridge, in Canaan.

NEW INCORPORATIONS.

HARRISBURG, PA.—Beaver Springs Electric Light Company. $6,000.

CONCORD, N. H.—Troy & Fitzwilliam Light and Power Company. $15,000.

COLUMBUS, OHIO—Kirtland Telephone Company. Increased from $2,500 to $5,000.

COLUMBUS, OHIO—The Chardon Telephone Company. Increased from $25,000 to $50,000.

LEXINGTON, S. C.—The Citizens' Telephone Company. $1,000. Incorporators: J. E. Coughlin and A. J. Fox.

SALEM, ORE.—West Oregon Telephone Company. $2,000. Incorporators: Charles Baker, G. P. Gross, E. S. Kruse.

HARRISBURG, PA.—Wilkins Electric Power Company. $5,000. Directors: J. G. Frazer, J. G. Evans, R. T. Russell, Pittsburg.

BRADDOCK, PA.—Bessemer Electric Power Company. $5,000. Directors: J. G. Frazer, J. G. Evans, R. T. Russell, Pittsburg.

PENN TOWNSHIP, PA.—Taylor Electric Power Company. $5,000. Directors: J. G. Frazer, J. G. Evans, R. T. Russell, Pittsburg.

GUTHRIE, O. T.—Medford Rural Telephone Company. $3,000. Incorporators: D. L. Cline, J. Sharp and W. S. Long, all of Medford.

WINDSOR, N. Y.—Lester Telephone Company. $2,000. Incorporators: Wiber Brink, Levi Cresson, J. E. Kent, Windsor, N. Y.

EDWARDSVILLE, ILL.—Litchfield Traction Company. $5,000. Incorporators: Charles B. Munday, Jr., M. J. Buscher and G. L. Settlemire.

PORTLAND, ME.—Terra Telegraph and Signal Company. $3,000,000. Directors: M. W. Baldwin, G. C. Knight and J. E. Manter, Portland, Me.

MACDOUGALL, N. Y.—The MacDougall Telephone Company. $5,000. Incorporators: A. Baldridge, R. C. Allen, A. Baldridge, Jr., MacDougall, N. Y.

BLAINE, ME.—Mars Hill & Blaine Electric Light and Water Company. $10,000. President, A. O. Nutter, Mars Hill; treasurer, G. W. Young, Blaine.

LANSING, MICH.—St. Joe River Traction Company. To build an electric line from the Indiana state line to Benton Harbor and Kalamazoo. $750,000.

DENVER, COL.—North Boulder Light, Power and Water Company. $50,000. Incorporators: Franklin R. Anson, Herman H. Mund and Harry J. Gibbon, of Denver.

CLEVELAND, OHIO—The Toledo Transit and Light Company. $10,000. Incorporators: C. E. B. Lemson, J. M. Ormond, Charles Fox, C. A. Thatcher and E. P. Mull.

AUSTIN, TEX.—Dalhart Ice and Electric Company. To operate an ice and electric plant. $100,000. Incorporators: W. H. Wolff, C. G. Foulks and C. C. Slaughter, all of Dalhart.

COLUMBUS, OHIO—Columbus Northern Railway, Power and Equipment Company. $300,000. Incorporators: John G. Webb, Walter A. Black, George Whysall and Oscar M. Gottschall.

RICHMOND, VA.—The Luray Electric Company. $15,000. Officers: E. C. Harnesberger, president and treasurer; E. D. Weaver, vice-president; R. T. Morrison, secretary, all of Luray.

SAN DIEGO, CAL.—Oceanside Electric and Gas Company. $25,000. Directors: E. V. Griffes, C. J. Walker, P. E. Hatch and S. F. Esterbrooks, of Long Branch, and M. J. Shaul, of Oceanside.

WASHINGTON, D. C.—The State Mutual Telephone Company. $50,000. Incorporators: A. D. Weller, T. J. Gray, T. B. Lee, Frank R. Hollingshead, E. M. Root, J. Dan Blackistone and A. J. Bette.

SWEET SPRINGS, MO.—Sweet Springs Telephone Company. $20,000. Incorporators: B. H. Dickson, R. Samuel Hays, Charles K. Smith, J. F. Coulter, Henry Park, J. R. Smith and W. L. King.

DES MOINES, IOWA—Spring Brook Rural Telephone Company; $1,000; incorporators, Henry Miller and others. Gaza & Sutherland Telephone Company; $600; incorporators, Frank Tierney and others.

LIVINGSTON MANOR, N. Y.—Livingston Manor Electric Company. To manufacture electricity. $32,000. Incorporators: V. A. Finch, George S. Woolsey, W. R. Woolsey, Livingston Manor, N. Y.

OAKLAND, CAL.—Mount Diablo Light and Power Company. $50,000. Directors: J. W. Burge, of Haywards; C. A. Jeffrey, L. B. Smith and Wilton Shubaw, of Oakland, and G. J. Clark, of San Leandro.

CLEVELAND, OHIO—The Barlow & Watertown Telephone Company. To operate telephone lines in Washington and Morgan counties. $10,000. Incorporators: S. W. Hawey, Roscoe Wolcott, H. Fisher and others.

LANCASTER, PA.—Lancaster & Quarryville Street Railway Company. $48,000. Incorporators: R. Herr, Galen J. P. Raub, Reuben D. Herr, William B. Conter, Andrew Herr, Jacob W. Breneman and D. Jefferson Herr.

GUTHRIE, O. T.—Territorial Engineering Company. To construct and operate street railways and electric light and gas plants. $25,000. Incorporators: G. W. Burke, F. H. Peckham and M. L. Cunningham, of Oklahoma City.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—At a meeting of the board of directors of the American Electrochemical Society, held October 1, the following were elected to membership: Elliot M. Sergeant, Boonton, N. J.; E. P. Schoch, Austin, Tex.; Martin L. Griffin, Mechanicsville, N. Y.; Ernest S. Wittnebel, New York city; F. F. Schuetz, New York city. The seventh general meeting of the society will be held in Boston and Cambridge, Mass., during Easter week, 1905.

PHILADELPHIA SECTION OF THE AMERICAN ELECTROCHEMICAL SOCIETY—A meeting of the Philadelphia section of the American Electrochemical Society was held at the Hotel Market, South Eighth street, Philadelphia, Pa., on the evening of November 7. A paper contributed by Mr. Gustave Gin, dealing with his electrical method of manufacturing steel, was read in abstract by Mr. S. S. Sadtler. The paper by Dr. Héroult, read at the recent International Electrical Congress, was also taken up for debate, and to cover the field entirely Dr. G. P. Scholl submitted a brief résumé of other electrical processes for making steel. This meeting was less formal than the preceding ones, it being thought that the German method of conducting such meetings would be more enjoyable and not less beneficial.

THE PITTSFIELD BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—A meeting of the Pittsfield branch of the American Institute of Electrical Engineers was held in the office of the Construction Company of America, 19 West street, on October 28, 1904. Mr. D. B. Rushmore was chairman of the meeting, and twenty-five members and guests were present. The chairman gave a brief sketch of the Institute's history, the development of the local branches, and the progress which had been made. He also suggested an outline of the work for the coming year, which may include discussion of the Institute papers, original contributions by local members, and addresses by prominent engineers. At this meeting some of the papers presented at the Chicago meeting of the Institute were read. Mr. Leonard Wilson presented a paper on "The Conditions for Continuous Service over Lines Operated in Parallel," by M. H. Gerry, Jr. Mr. Wilson contributed a considerable discussion on this subject. The paper on "The Use of Ground Shields in Transformers," by J. S. Peck, was read by S. H. Blake. Mr. E. A. Bessey read a paper entitled "The Protection of High-Pressure Transmission Lines from Static Discharges," adding a contribution of his own to the discussion. Mr. F. V. Nicholls opened the discussion by contrasting the switch arrangements necessary for long-distance power transmission systems and those for large power-houses in great cities. Mr. J. J. Kline contributed information with regard to the operation of the California transmission systems. Mr. G. G. Ponti described parallel operation of transmission lines in northern Italy, and also some of the lightning arresters used there. Mr. George Carter gave a description of the static interrupter. Mr. A. W. Pierce and Mr. Wilson contributed to the discussion on ground shields for transformers. The next meeting will be held on November 11, and at this time Mr. Gilbert Wright will present an original contribution on the subject of "Power-House Design," with special regard to the large power-houses in New York city.

TELEPHONE AND TELEGRAPH.

BOONE, IOWA—The Boone Telephone Company will make improvements to its system.

ESTHERVILLE, IOWA—The Emmet County Telephone Company seeks a local franchise.

BERKSHIRE, N. Y.—A telephone line is being extended from this place to Rawson Hollow.

HALLECK, MINN.—The Home Telephone Company at Cottonwood will build several rural lines.

JEFFERSON, N. Y.—A new telephone line is to be built between Jefferson and Stamford *via* Churchill's.

MT. MORRIS, N. Y.—The Nunda Telephone Company is extending its lines to the town of Mt. Morris.

GAINESVILLE, MO.—John C. Harlin is building a telephone line from this place to Bakersfield *via* Udall.

COOLEYVILLE, MASS.—The Highland Telephone Company is at work on a line to Locks Village and Wendell.

LOS ANGELES, CAL.—The Home Telephone Company has completed a line from Glendale *via* La Crescenta and Cañada.

ALVIN, TEX.—The Alvin & Angleton Telephone Company is arranging to extend its line to Friendswood, in Galveston County.

RICHFIELD SPRINGS, N. Y.—Farmers between New Berlin and King Settlement have organized to build a telephone line to connect with the New Berlin exchange.

ALTOONA, PA.—The Postal Telegraph Company has completed the stringing of two lines between Pittsburg and Philadelphia along the right of way of the Pennsylvania Railroad Company.

LOS ANGELES, CAL.—Plans are being prepared for a telephone exchange building to be erected by the Home Telephone Company at Redlands. It will be 40 by 100 feet and thoroughly fireproof.

CALUMET, MICH.—The Michigan State Telephone Company is installing a common battery system at Portage Lake. Similar improvements will shortly be made in Houghton, Hancock, Calumet and other cities.

MUNCY, PA.—At a meeting of the Muncy Creek Telephone Company, the following officers were elected: president, T. W. Raper, of Laidsville; vice-president, U. G. Boyer, of Clarkestown; secretary, W. S. Opp, of Opp; treasurer, P. N. Opp, of Opp.

HUNTSVILLE, ALA.—The property of the Huntsville, Guntersville & Gadsden Telephone Company has been sold by decree of chancery court to the creditors. The purchasers own the principal stock of the Gurley and New Hope Telephone companies, and will merge the systems.

GRATIOT, OHIO—The Gratiot & Brownsville Telephone Company, with the exchanges located at Gratiot, which was organized May 21, 1904, has already put in over 100 telephones in and around Gratiot, Brownsville, Mt. Perry and Hopewell, and new subscribers are constantly being added.

FARMINGTON, N. H.—The wires of the Citizens' Telephone Company, of Laconia, are being extended to Alton Bay, with the intention of ultimately reaching this city by way of Farmington. It is expected that the company will ask for a franchise through this section in the near future.

TRENTON, N. J.—Papers have been filed in the office of the secretary of state merging the Telephone and Telegraph Company of New Jersey with the American Telephone and Telegraph Company of New Jersey under the corporate name of the latter company. The companies are identified with the Bell telephone system.

HATTIESBURG, MISS.—The Cumberland Telephone Company has been granted a twenty-five-year franchise. This company will immediately commence the work of putting in standard Bell long-distance metallic telephones in place of those now in use. A new switchboard will be put in and the entire system in Hattiesburg will be replaced within the next four months. The council granted the company nine months in which to complete the work.

SARATOGA SPRINGS, N. Y.—The Greenfield Telephone Company has elected the following officers for 1905: president, William H. Harris; vice-president, John S. Jones; secretary, Benjamin S. Robinson; treasurer and general superintendent, Clarence E. Latham; directors: Charles S. Latham, Henry Menshousen, C. W. Spaulding.

LYONS, N. Y.—There is talk of a deal to consolidate the Wayne Telephone Company, of which the Lyons Telephone Company is a branch, with the Wayne-Monroe Telephone Company. With the Wayne-Monroe service Lyons would have the advantage of a telephone service to Oswego and other intermediate points as far west as Buffalo.

NEWBURGH, N. Y.—The Hudson River Telephone Company has leased its Walden branch to C. Fred Fowler, of Walden, for a term of five years. The branch includes the Walden, Wallkill, Pine Bush and Montgomery lines. The Hudson River Telephone Company installed its lines in Walden two years ago with thirty-five telephones. There have since been added sixty-nine telephones, making in all 104. Mr. Fowler expects to extend the line to Gardiner, and also thinks of running it through the rural districts.

CUMBERLAND, MD.—At the annual meeting of the Western Maryland Telephone Company the following board of directors and officers were reelected: directors, B. A. Richmond, J. H. Holzshu, Clayton Purnell, H. H. Dickey, James A. MacHenry, H. J. Glick, DeWarren H. Reynolds, Duncan R. Sloan and D. P. Miller; president, James A. MacHenry; vice-president, D. R. Sloan; treasurer, Henry J. Glick; secretary, Carl C. Hetzel; general manager, George W. Randall. The reports showed the company to be in excellent condition. Although only nineteen months in actual service, the company has now 1,700 telephones in Allegany County, 1,350 in Cumberland, 220 in the Frostburg circuit and 130 in Lonaconing. Connections are being made with every town in this county.

TROY, N. Y.—Men are now at work extending the lines of the North Creek Telephone Company from Watertown south through North Thurman and on to Stony Creek. This will open up a territory which heretofore has been out of reach of users of the telephone or the telegraph. The lines of the North Creek company are made up of the lines formerly controlled by L. B. Pereau, of North Creek, who is the manager of the new company. The company operates the lines into Chester, Pottersville, Bakers Mills, Wevertown and other points in the northern part of the country. The lines are also to be extended west and north from North Creek and into the Sacandaga valley, but it is not expected that these extensions will be completed until after the Thurman-Stony Creek lines are finished.

DETROIT, MICH.—The Ontario Independent Telephone Company effected permanent organization and elected officers in Windsor on October 27. The company will start at once to construct its lines throughout Essex County, beginning at Amherstburg. Four hundred subscribers have already been secured in the county. The new automatic exchange system will be installed. The company's lines will extend east through Ontario. The following officers were elected: president, John H. Connelly, Windsor; vice-president, James A. McRae; treasurer, Fred J. Lawrence; secretary, A. D. Prosser; general manager, C. W. Taylor; assistant general manager, P. T. Chesley; directors, John H. Connelly, Mayor Brault, of Amherstburg; J. A. McRae, P. T. Chesley, J. R. Brooks, A. D. Prosser, C. W. Taylor and Fred J. Lawrence.

BUFFALO, N. Y.—At the recent annual meeting of the Frontier Telephone Company the following board of directors was elected for the ensuing year: William H. Andrews, Charles E. Austin, Martin Carey, William A. Douglass, Charles W. Goodyear, Charles B. Hill, Clark L. Ingham, H. D. Kirkover, Andrew Langdon, Elgood C. Lufkin, Henry H. Persons and George A. Plimpton, all of Buffalo; John Markle, of New York; Harry B. Schooley, of Wilkesbarre, Pa., and Samuel E. Wayland, of Scranton, Pa. The new board has elected the following officers: Henry H. Persons, who has been first vice-president and general manager of the company for the past year, was elected president for the ensuing year. E. C. Lufkin was elected first vice-president. S. E. Wayland, of Scranton, Pa., was elected second vice-president. Fred L. Mesmer, now auditor of the company, was elected treasurer. John Jolly, the present contract agent of the company, was elected secretary. The affairs of the company were shown to be in excellent condition, and important action was taken by the board which assures aggressive work on the part of the company for the coming year.

PERSONAL MENTION.

MR. LOUIS BARNES, who has been with the Southern Bell Telephone Company for some time past, has resigned to take a position with the Columbus Automatic Telephone Company, Columbus, Ga.

MR. WALTER B. MANNING has been elected vice-president of the Pike Adding Machine Company of New Jersey. The Pike adding machine is a new apparatus automatically worked by electricity. Mr. Manning's office is at 180 Broadway, New York city.

MR. PRESTON PLAYER, superintendent of the Edison Electric Illuminating Company's plant at Brockton, Mass., has been promoted and will have charge of the power-house of the Blue Hill Electric Railroad Company, with headquarters at Canton Junction.

THE NEW YORK ELECTRICAL SOCIETY announces the following members elected at the last meeting: Thomas Smith, Brooklyn, N. Y.; W. E. McCoy, Samuel T. Lawrence, Arthur L. Kane, Francis D. Williams, Harry Haggerty, New York city; Philip B. Rice, Stamford, Ct.; Stephen H. Sharpsteen, Robert J. Cory, Harry Willers, J. H. Willers, New York city; George R. Larwill, Brooklyn, N. Y.

MR. EDWIN R. WEEKS, the well-known pioneer central station operator, and a member of the firm of Weeks, Kendall & Newkirk, of Kansas City, Mo., is the author of an interesting article in the Kansas City *Journal*, of October 16, describing the work of the Humane Society, of Kansas City, Mo. Mr. Weeks has been interested in this society since its formation in December, 1883. During his connection with the society it has performed much truly remarkable work and experienced wonderful growth. It will be remembered that during the recent floods in Kansas City Mr. Weeks was the leader of a rescuing party which saved from destruction a very large number of unfortunate animals which had been abandoned by their owners.

MR. GEORGE HOWE, M. E., is planning a course of lectures to meet the requirements of practical engineers and engineering students who have not had the advantages of a college education. His idea is to equip such men with a fundamental knowledge of mathematics and the theories of electrical engineering. The course will extend over a period of six months, and consist of two lectures per week. The lecture hall of the Price-Cottle Conservatory of Music, 2105 Seventh avenue, New York city, has been engaged for these lectures. Mr. Howe was formerly instructor of physics at Tulane University and lecturer in electrical engineering in the Young Men's Christian Association night lecture courses, New Orleans, La. His present address is 129 West One Hundred and Seventeenth street, New York city.

MR. FRANK Z. MAGUIRE, vice-president of the American De Forest Wireless Telegraph Company, tendered a complimentary dinner, at the Hotel Cecil, London, England, to Dr. Lee De Forest, on the evening of October 25, upon the occasion of his departure for the United States. Sir William Preece presided, and among those who had accepted invitations to be present were Professor W. E. Ayrton, J. Swinburne, A. A. C. Swinton, Professor G. M. Minchin, Colonel H. C. L. Holden, Captain Lionel James, Admiral Sir J. D. Hay, S. Barber, F. C. C. Neilson, G. MacLean, A. L. C. Fell, J. H. Carson, Sir Dudley Forwood, E. H. Johnson, R. Wallace and N. Maskelyne. Sir William in a short speech reviewed the history of developments in wireless telegraphy. He called attention to the remarkable work which had been undertaken with regard to the service of the London *Times* during the present war between Japan and Russia, and complimented Captain James for his work in this connection. Dr. Lee De Forest, in responding to this toast, detailed his negotiations with Captain James in establishing the *Times*' wireless war service. Captain James responded to a toast in which his name was coupled with "the press." Other speakers were Professor Ayrton and F. Z. Maguire.

LEGAL NOTE.

JERSEY CITY BRINGS SUIT TO EJECT PUBLIC SERVICE CORPORATION FROM THE STREETS—The city of Jersey City, N. J., on November 3 commenced suit against the Public Service Corporation, which operates the street cars in that city, to eject that company from Montgomery street, between Warren and Washington streets. Technically, this involves but one block. The point at issue, however, involves nearly every street in Jersey City on which cars are run under the charter of the Jersey City & Bergen Railway Company. The aim of the suit is not to stop trolley traffic on any street, but to determine if the city has the right to eject the trolley company. If this suit is decided favorably to the city, it will be able to make much better terms with the railway company, or else sell the right to run trolley cars in the streets to the highest bidder.

AUTOMOBILE NOTE.

LETTER TO THE SUPERINTENDENTS OF RAILROADS IN THE STATE OF NEW YORK—The following letter has been sent by the secretary of the American Automobile Association to all of the general superintendents of railroads operating in the state of New York. A similar letter has also been sent to all railroads operating in the state of New Jersey: "Many complaints have come to us from the drivers of automobiles in this state, that very great laxity exists on the part of railroad locomotive engineers in failing to comply with the law regarding the ringing of a bell or blowing of a whistle on approaching a highway crossing at grade. It may be inferred that some of the serious accidents which have occurred at grade crossings recently were due to such laxity. In view of the many railroad crossings at grade which at present exist in the state of New York, we would respectfully request that you immediately call the attention of your superintendent and locomotive engineers to this complaint, and to section 421 of the penal code, which defines such failure to comply with the law as a misdemeanor. Such action on your part will tend to prevent accidents and the possible prosecution of your locomotive engineers in accordance with the code. S. M. Butler, secretary."

EDUCATIONAL.

PROFESSOR WILLIAM S. ALDRICH, director of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., has been informed by D. M. Ellis, director of education and social economy, New York exhibit, Education Building, World's Fair, St. Louis, that the international jury in group 3, higher education, technical schools, etc., has awarded a bronze medal to the Thomas S. Clarkson school. The exhibit was warmly commended by the members of the jury, and has been a source of interest to visitors throughout the summer.

OBITUARY NOTICES.

MR. JAMES H. WARD, an old business man of Poughkeepsie, N. Y., died on the evening of November 1 at Poughkeepsie. He was prominent in many Poughkeepsie institutions. At one time Mr. Ward was president of the Poughkeepsie Merchants' Association, and at the time of his death was president of the Poughkeepsie Building and Loan Association. He was one of the founders of the Poughkeepsie Electric Lighting Company, and a director of the Merchants' National Bank, as well as a trustee of the Presbyterian Church. Mr. Ward was sixty-nine years of age.

JUDGE JAMES M. THOMAS died on Tuesday, November 8, at his home in Irvington, N. Y., aged forty-six years. Judge Thomas was born in Clarksburg, Ohio, and was a student at Wesleyan University, teaching school and studying law at Chillicothe, Ohio. He was admitted to the bar, June, 1884, and served two terms as probate judge in Ross County, Ohio. Judge Thomas was probably one of the most widely known independent telephone men, serving for some years as president of the Independent Telephone Association of the United States, and being officially connected as president of the United States Telephone Company, with headquarters at Cleveland, and as president of the American Cable and Telephone Company, with headquarters at New York. Within the past two years Judge Thomas had been connected with the reorganization of the Aetna Indemnity Company, making his headquarters in New York city. He was a member of the Union League Club and the Ohio Society.

ELECTRICAL SECURITIES.

Contrary to expectations, the war scare abroad and the proximity of the national election close at hand caused no reaction worth considering in the stock market last week. While there were some declines early in the week, many issues scored new high prices for the year and made considerable net gains for the week. While, for a considerable period just passed, it was felt that the outcome of the national campaign would not affect the industrial conditions in general—the commercial element being satisfied with the promises of either party—it is now apparent that the immediate speculative future will be determined by the election outcome. The general opinion at this time is that much new work is about to be undertaken at this time, now that the election is over and there is no further opportunity for marking time. One way or the other, it will be but a short time before the indications will be very clearly outlined. In many directions there is evidence that the progress of industrial revival is going along very smoothly. Bank exchanges, with considerable expansion, reflect a greater business animation. It is also a matter of congratulation that the Fall River mills are shortly to open.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 5.

New York:	*Closing.*
Brooklyn Rapid Transit	67
Consolidated Gas	216
General Electric	173¼
Interborough Rapid Transit	152½
Kings County Electric	205
Manhattan Elevated	161½
Metropolitan Street Railway	122⅝
New York & New Jersey Telephone	156
Westinghouse Manufacturing Company	186

The Consolidated Gas Company will complete its fiscal year December 30, and, while figures are lacking, there is reason to believe that both the sales of gas and electricity for the year will show a substantial increase over the preceding year.

Boston:	*Closing.*
American Telephone and Telegraph	141½
Edison Electric Illuminating	240
Massachusetts Electric	55¾
New England Telephone	135
Western Telephone and Telegraph preferred.	97

The directors of the Edison Electric Illuminating Company have voted to recommend to stockholders the issue of 10,450 additional shares of stock. They also voted to call a special meeting of stockholders on November 18 to act on the same. The new stock will be issued to stockholders at $200 a share, in accordance with the order of the gas commission July 10, 1903, authorizing the company to issue 20,000 shares at $200 a share for the acquisition of suburban properties and for extensions.

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	74
Electric Storage Battery preferred	74
Philadelphia Electric	9
Union Traction	58½
United Gas Improvement	104½

It is stated that negotiations looking to the acquisition by the United Gas Improvement Company of the American Light and Traction Company have been reopened. The American Light and Traction Company was formed under the laws of New Jersey in April, 1901, and has acquired the following properties: Western Gas Company, Milwaukee; St. Paul Gas Light Company, St. Paul; Grand Rapids Gas Light Company, Grand Rapids, Mich.; St. Joseph Gas Light Company, St. Joseph, Mo.; Madison Gas and Electric Company, Madison, Wis.; Binghamton Gas Works Company, Binghamton, N. Y.; Southern Light and Traction Company, San Antonio, Tex., and Consolidated Gas Company of New Jersey, Long Branch, N. J. The company has an authorized capital of $15,000,000 common and $25,000,000 preferred stock, of which there has been issued $4,680,400 of the former and $9,396,900 of the latter.

Chicago:	*Closing.*
Chicago Telephone	122½
Chicago Edison Light	164
Metropolitan Elevated preferred	67½
National Carbon	39
National Carbon preferred	108
Union Traction common	9⅜
Union Traction preferred	37⅝

The daily average for October of passengers on the Northwestern Elevated was 73,385, an increase of 1,769.

Receivers of the Union Traction and underlying companies have decided that the interest on the first consolidated mortgage bonds, due December 1, shall be paid.

ELECTRIC RAILWAYS.

JOLIET, ILL.—The new interurban electric line between Joliet and Aurora has been opened.

DUBUQUE, IOWA—Work has been started on the Dyersville & Northern Railway Company's line.

AFTON, N. Y.—The survey has been commenced on the proposed trolley road from Oneonta to Catskill.

AVOCA, N. Y.—A franchise has been granted to the promoters of the proposed electric railroad between Rochester and Elmira.

CLEVELAND, OHIO—The construction work on the line of the Cleveland Electric railway, for which the council of Collinwood granted a franchise recently, will be started shortly.

ALEXANDRIA, IND.—The Alexandria city council has granted the Indianapolis, Hartford City & Celina company a fifty-year franchise. The company has one year in which to build the line.

WASHINGTON, PA.—It is stated that the Monongahela, Ellsworth & Washington Railway Company will begin the construction of a trolley line between Washington and Monongahela within a few weeks.

CLYDE, N. Y.—The contract for building the Rochester, Syracuse & Eastern Trolley Railroad from Palmyra to Lyons has been let to J. G. White & Company, of New York. The work will be commenced soon.

PITTSBURG, PA.—The Valley Realty Company, of Wilmerding, is said to be back of a project to build a new street car line to connect Wilmerding with the borough of Walls. The new line will be about two miles long.

BATTLE CREEK, MICH.—It has been rumored that the Michigan Central will change its Battle Creek & Sturgis branch to an electric line. The road runs from this city to Sturgis and Goshen and has never been a paying line.

NORWICH, CT.—The Chenango Railroad Company has been organized among Boston and New York men under the laws of Massachusetts for the purpose of constructing and operating an electric railroad through the Chenango valley.

TOLEDO, OHIO—It is announced that work is being pushed rapidly on the extension of the Toledo & Indiana from Wauseon to Bryan and that cars will be running through to the latter town by February 1. The power station will be located at Stryker.

WHITE HALL, ILL.—A new electric road is projected, to run from Springfield *via* Auburn and Waverly to White Hall. Between Waverly and White Hall it will run through a fine farming country that has no railroad facilities. Isaac A. Smith is in charge of the survey.

SACRAMENTO, CAL.—Eastern money has been obtained to build an electric road between San Mateo and San Jose. A private right of way for the line has been obtained, with the exception of a short distance. The new road will be about thirty-five miles in length and will cost about $875,000.

PLEASANTVILLE, N. J.—The Atlantic & Suburban Trolley Company is making arrangements to run the present tracks down the beach as far as Chelsea. When complete this road will run from Somers Point, through Pleasantville, across the meadows and down the beach to Chelsea.

MORRISTOWN, TENN.—Eastern capitalists have been here recently for the purpose of organizing a company to build electric car lines on the principal streets. They have already made application to the secretary of state for a charter and the town council will be requested to grant a franchise.

VANCOUVER, BRITISH COLUMBIA—James Finlay and F. J. Weeks have made application, under the tramway companies incorporation act, for the incorporation of a company to construct and operate a tramway between Sullivan Hill, Southeast Kootenay and the North Star branch of the Crow's Nest Pass Railway.

SNOHOMISH, WASH.—The Snohomish-Cherry Valley electric railway held an important meeting in this city recently at which the following officers and trustees were elected: president, J. W. Hall; vice-president, F. S. Anderson; secretary, E. L. Colburn; treasurer, W. M. Snyder. Trustees: F. S. Anderson, J. W. Hall, E. Colburn, Matt. Albert, W. M. Snyder, P. J. Farley and W. C.

Brown. The line to be built by this company extends from here to Cherry Valley, in King County, and is the link in the trolley line extending from Seattle to Everett, Snohomish to Tolt and back again to Seattle. It is stated work will begin soon.

PORTLAND, IND.—The Genevia Traction Company has taken all of the right of way for its line except three miles between Marion, Ind., and Celina, Ohio, and purposes to have some of the grading done this fall. The project has been financed by eastern capitalists, represented by Dudley M. Shively, of South Bend.

LAWRENCE, KAN.—The Kansas City & Bonner Springs Electric Railway Company has been granted the right of way to construct and operate an electric line from Bethel, Kan., a town six miles west of Kansas City, Kan., to Bonner Springs. The line is to be in operation in eighteen months. The right of way is now being graded.

STILLWATER, MINN.—At a meeting of the South Stillwater village council a franchise was granted to the Twin City Rapid Transit Company to lay its tracks in the streets of the village, connecting with the line of the company at Stillwater. The line will be about three miles long and must be built within eight months.

MILWAUKEE, WIS.—The Wisconsin Traction Company, which is planning the construction of an electric railway between Fond du Lac and Milwaukee, has stated that the route is selected, the distance being about sixty-one miles. Part of the right of way is secured and there is every probability that construction will be begun soon.

INDIANAPOLIS, IND.—The Indianapolis, Logansport & South Bend Traction Company has been incorporated by Logansport and South Bend capitalists. The road is to run from Logansport, through Rochester, Plymouth and Mishawaka, to South Bend, sixty-five miles. It will connect at Logansport with the Indianapolis & Northwestern.

GREENSBURG, IND.—The city council has passed the Columbus, Greensburg & Richmond tax levy ordinance to provide for the subsidy voted the proposed road and has extended the franchise of the traction company, with the provision that work shall begin on the line by May 1, 1905, and be completed between here and Columbus by May 1, 1906.

NEW LONDON, CT.—The contract for building and equipping the East Lyme street railway has been awarded to M. W. Burwell, of New Haven, who will not only build the road, but will furnish all the cars and equipment. Work upon the line has been begun and, if the weather conditions are favorable, the line will be completed by January 1.

HAGERSTOWN, MD.—It is estimated that the proposed electric railway to be built between this city and Waynesboro will cost about $200,000. De Warren H. Reynolds and W. A. Morgart, of Cumberland, are the promoters of the project. Rights of way have been secured the entire distance and the plans are expected to mature at an early date.

PETERSBURG, W. VA.—A company composed of Chicago capitalists has purchased the right of way for an electric railroad which is to be constructed between Keyser and Petersburg, a distance of forty-two miles. Surveyors are working over the route at this time. Mr. B. W. Wright, of Cumberland, is transacting the business for the company.

HARTFORD, CT.—The promoters of the trolley line which the Rockville, Broad Brook & East Windsor Street Railway Company proposes to build confidently expect that construction operations will commence in the spring. Surveys have been completed, and arrangements for financing the enterprise will now be undertaken. Of the 1,000 shares of capital stock of the company about 600 have been sold.

CARTHAGE, MO.—The stockholders of the Southwest Missouri electric line at their annual meeting reelected the board of directors as follows: Edward S. Herman, E. Z. Wallower and A. G. Knisley, of Harrisburg, Pa.; Wm. Wertz and H. W. Wertz, of Newport, Pa.; Will Chinn, of Webb City; Samuel McReynolds, of Carthage, and A. H. Rogers, of Joplin. The directors afterward reelected the officers.

GRAND HAVEN, MICH.—The board of supervisors has granted a franchise to the Riverside Electric Railway Company to run its road through the county. The company is given the privilege of erecting a bridge across Grand river at Bass River. The franchise is for three years. Promoters of the enterprise state that the road will be built in two years. The road will run from this city to Grand Rapids.

PATCHOGUE, N. Y.—Construction is to be started shortly on a trolley line between Jamaica and Brookhaven, the state railroad commissioners having granted the required certificate to the South Shore Traction Company. The new line, when completed, will connect Brookhaven, which is five and one-half miles east of this place, with New York city, through Jamaica and Brooklyn. It will pass through all south side villages.

BUFFALO, N. Y.—A new electric line from East Toledo to Bono is projected. It is said that all the right of way for the line has been secured and that the company will be organized in a short time. The road, if constructed, will run through Booth, through Curtise, close to Momeneetown, and on to Bono. The district is densely populated by market gardeners and fruit growers, and it is thought the road will do a large freight business.

SARATOGA, N. Y.—Walter P. Butler, of this place, has been appointed by Justice Edgar A. Spencer, of Gloversville, receiver to sell the trolley system, known as the Ballston Terminal Railway, to meet three liens aggregating $361,000. The first, for $11,000, is held by the Adirondack Trust Company, of Saratoga; the second, for $250,000, by the Metropolitan Trust Company, of New York, and the third, for $100,000, by the Citizens' Savings and Trust Company, of Cleveland.

PITTSBURG, PA.—The New Brighton road branch of the Pittsburg Railways Company will be extended to Bellevue in the spring, thus giving an additional outlet to that suburb, relieving the crowded condition of the present Bellevue and Avalon line. Work on the construction of the road will be commenced as early in the spring as the weather will permit. The company has for some time been contemplating this action, and secured certain rights of way in Bellevue to carry out the project.

FORT COLLINS, COL.—The city council has passed an ordinance giving the Northern Colorado Electric Railway Company the right to build, operate and maintain an electric railway along the business streets of the city. The life of the franchise is fixed at forty years and the company is to file maps showing the location of the proposed line or lines within three months from the date of the passage of the ordinance, and to begin actual construction work within one year thereafter, and complete the entire system within two years.

TOPEKA, KAN.—The Wellington & Cowley County Traction Company, with $500,000 capital, has been granted a charter. The object of the concern is to build a network of electric railways in Sumner and Cowley counties. All the big towns in these two counties, including Wellington, Winfield and Arkansas City, are to be connected. The incorporators are: George H. Hunter and C. A. Gambrill, Wellington; H. F. Harbaugh, and John Blattner, Rome; L. H. P. Northrup, C. A. Scruton and S. P. Gould, Arkansas City.

BIRMINGHAM, ALA.—The city council of East Lake, a suburb, has granted the Birmingham Railway, Light and Power Company, of this city, a franchise to operate a new loop line in that town. The new line will form a complete loop and will encircle the principal residence streets and avenues of East Lake. A system of transfers and a schedule convenient for making connections with the line to Birmingham will be arranged. Work on the East Lake loop will be commenced about next February and will be completed as early thereafter as possible.

BATH, N. Y.—At a meeting of the Bath town and village boards of trustees, a franchise was granted to Richard Barlow & Company to construct and operate through the town and village the proposed electric railroad between Rochester and Elmira. It is expected work will shortly be commenced upon the line, which will receive its power from a dam in the Genesee river above Mt. Morris. The road will parallel the Erie from Elmira to Wayland, where it will diverge, touching Dansville, Mt. Morris, Groveland, Piffard, Geneseo and thence into Rochester.

INDUSTRIAL ITEMS.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., has been awarded a grand prize and gold medal for tools and machines exhibited at the Louisiana Purchase Exposition, St. Louis, Mo.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has been awarded a gold medal for its electrical fans and motors at the St. Louis Exposition. This company made an elaborate display in the Electricity Building.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in its calendar for November of the great men of science and engineering series gives a short biography of Sir William Crookes. This also includes a photograph in colors of this eminent scientist.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in a new bulletin details the advantages of graphite for motors. This company makes a variety of graphite substances for lubrication. The bulletin is handsomely printed, and comes in an attractive folder in two colors.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in bulletin No. 6010 describes knife switches. In addition to a careful description with a price list and code word for ordering, there are numerous illustrations and dimension plates showing these knife switches in every conceivable variety.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 529 West Thirty-fourth street, New York city, has closed a contract with Westerly, R. I., for its new street lighting system, which embraces a fifty-light circuit. The G. I. company has removed its Cleveland branch office to 61 Perin Building, Cincinnati, Ohio.

H. M. BYLLESBY & COMPANY, New York Life Building, Chicago, Ill., which is at present constructing the gas plant at Muskogee, I. T., has been retained as engineer by the Muskogee Electric Traction Company, to design and construct a railway in the town of Muskogee, with an approximate trackage of 4.7 miles.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York city, is now operating factories at Hoboken and Bayonne, N. J. Its Chicago office, under the management of I. A. Bennett, is at 529-530 Monadnock Building. Its San Francisco office, under the management of the C. F. Sloan Company, is in the Crossley Building.

THE T. R. ALMOND MANUFACTURING COMPANY, 83-85 Washington street, Brooklyn, N. Y., is the manufacturer of flexible tubes for electric light brackets and electric portable lights. This company will be pleased to send illustrated literature upon request. The Almond flexible tube is made in lengths from six to twenty-eight inches.

THE COLBURN MACHINE TOOL COMPANY, Franklin, Pa., will be pleased to send its new catalogue descriptive of the new Colburn universal saw-table. This is an adjustable saw-table, and in addition to its adjustable feature, is possessed of a number of characteristics which make it of exceptional value, particularly for complicated sawing.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., through Mr. A. A. Carlisle, has sold a complete electrical installation for the electric light plant at Amory, Miss., consisting of 150-kilowatt Triumph generator, Hardie-Tymes Corliss engine and boilers, Adams-Bagnall arc lamps, Peerless incandescent lamps and the necessary auxiliary material for installing the plant.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., has been particularly successful at the World's Fair, St. Louis. Two of its three exhibits have secured the highest awards. The Hunt industrial railroad received a gold medal for narrow-gauge railways, and the electric storage battery locomotive built by this company received the silver medal. This was the highest award for that type of locomotive.

THE LIBBEY GLASS COMPANY, Toledo, Ohio, has recently issued a handsome catalogue of thirty pages, containing illustrations of its inner globe products. This company is prepared to furnish inner globes for any lamps now on the market. The company makes a specialty of utilizing the waste material from its regular product, and announces that it is able to make high-grade inner globes at a moderate cost.

FRANK B. COOK, West Lake street, Chicago, Ill., has been making several additions to his line of specialties, and is now carrying a full line of construction material. A new catalogue is being prepared, which will include, among other things, marlin cable hangers, anchors, messenger hangers, pole steps, insulators, cross-arm braces, insulator brackets and wooden pins. A number of telephone companies have recently sent in large orders for Cook's No. 444 protector.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., one of the oldest and largest electrical supply houses in the country, has increased its warehouse capacity about fifty per cent, and added largely to its floor space. This extension has been made necessary to enable the Central Electric Company to handle its increasing business, and to give its patrons more efficient service. The company will carry a much larger stock, and will also greatly enlarge its shipping department.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletin No. 1059 describes and illustrates commutator truing devices. These devices are made in the shaft type and yoke type. The shaft type truing device is designed for mounting directly on the shaft of the armature or on the pedestal of small machines having removable bearing caps. For generators having brush mechanism mounted on a yoke carried by the field frame, the yoke type of truing device is recommended.

THE COMPILING BUREAU, 56 Pine street, New York city, will undertake the preparation of all forms of catalogues and circulars for the electrical trade. Copy is prepared for clients from matter provided in any form, and submitted by page or section until each division is approved. The company is in receipt of numerous testimonials as to the practicability and time and expense-saving methods which it has introduced. The principal members of the Compiling Bureau are W. F. Leggett and A. G. Brown.

THE NATIONAL CONDUIT AND CABLE COMPANY, 41 Park Row, New York city, manufacturer of bare copper wire, weather-proof wires and cables, lead-covered wires and cables for telephone, telegraph, electric light and power work, issues regularly a pamphlet entitled "Copper Gossip." The bulletin dated October 21 considers the outlook for improving business more encouraging. Copper for weeks has gradually been improving, and the prices are now the highest since the month of May. The present prices are thirteen and one-quarter cents for electrolytic wire bars, and thirteen and one-quarter and three-eighths for lake. Large sales have been made within the last few weeks, but principally for export.

THE WILE POWER GAS COMPANY, Rochester, N. Y., is publishing a catalogue descriptive of producer gas for power and fuel. The first section describes producer gas, its use and costs. This section enables a comparison of producer gas with other forms of power, and shows the economy of this fuel over modern steam plants. The company manufactures automatic gas producers fitted with its potential regulator. This potential regulator is fully described in section two of this catalogue. Section three of the catalogue describes suction gas producers manufactured by this company. These producers have been designed by experienced gas engineers, and embody features of European practice adapted to American conditions. The company will be pleased to send this catalogue to any who may be interested, upon application.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is mailing an attractive folder entitled "The Protection of Steel." This folder announces that the presence of sulphurous gases, cinders and steam, combined with exposure to the elements, provides a condition most favorable to the rapid corrosion of steel work. As an instance of the adequate protection provided by Dixon's silica graphite paint, however, a half-tone engraving is submitted showing a view of one of the fifteen-foot girders of the Willis avenue bridge over the New York, New Haven & Hartford Railroad Company's freight yards and the Harlem river, New York city. It is announced

that careful inspection has shown the paint to be in perfect condition after four years' exposure. The inspection further showed the unbroken condition of Dixon's "Black" on the rivet heads, angles, flanges and webs of all the girders.

JAMES CLARK, JR., & COMPANY, Louisville, Ky., will be pleased to send, upon request, their complete catalogue descriptive of electrically driven tools.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is distributing some interesting advertising literature calling attention to the Allen soldering compounds and other specialties.

THE UNITED TELPHERAGE COMPANY, 22 Broad street, New York city, in circulars Nos. 53 and 54 describes the application of electricity to several interesting industrial conveying systems.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., received a great many awards for its apparatus at the Louisiana Purchase Exposition. Among the twenty other awards which it received was a gold medal for electric flat-irons.

THE UNION ELECTRIC COMPANY announces its removal to new quarters at 603 North Calvert street, Baltimore, Md. Facilities for high-class electrical contracting will be very much increased. The old headquarters of the Union Electric Company were at 232 Park avenue.

THE HAWAII PROMOTION COMMITTEE, Honolulu, T. H., is distributing several booklets descriptive of Hawaii and the opportunities for investment in that territory. This committee represents the territory of Hawaii, the Chamber of Commerce and the Merchants' Association of Honolulu.

THE LECLANCHE BATTERY COMPANY, 111-117 East One Hundred and Thirty-first street, New York city, is calling attention to its new "Gonda Wedge Cell." This new type of cell is possessed of a number of features which the company claims greatly improve its performance. Full descriptive matter will be sent upon request.

McMEEN & MILLER, consulting telephone engineers, Chicago, Ill., have been given charge of the construction of a telephone system for the Quincy Automatic Telephone Company, Quincy, Ill. Mr. John M. Humiston, who will shortly join forces with this organization, has had a wide experience in work of this kind, and will be actively engaged with the project.

THE OSBURN FLEXIBLE CONDUIT COMPANY, Park Row Building, New York city, reports that it is obliged to keep its factory busy night and day to take care of the increased demand for its well-known "Flexduct" conduit. This material is gaining a new importance, due to the requirement of perfect insulation for interior wiring of every description.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., is again calling attention to the new type of moulding receptacle. An especially popular article of this new line is the catalogue No. 33582, which is a receptacle so designed that the incandescent lamp may be placed at an angle to the horizontal. The company will be pleased to send those interested a copy of its booklet on window lighting.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has printed two fine catalogues illustrating and describing the dynamos and motors built by the company. In addition to illustrations of the assembled motors, there are a number of views showing the different parts of the machines. Diagrams and dimensions are also given, together with the other physical constants of the machines.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., has designed a novel paper-weight in the shape of a ball-bearing casting. This unique souvenir gives a practical illustration of the frictionless bearing which this company is adapting to various forms of mechanical movements. Mr. S. S. Eveland is general manager, with headquarters at Forty-eighth street and Girard avenue.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing an elaborate souvenir descriptive of the power of the New York subway. This souvenir details the part played by one of the Allis-Chalmers four powers in the underground rapid transit system of New York. Numerous illustrations are given showing the various features of this huge power station. The ratings of the engines are given, and a concise description of the operation and output.

THE SUNBEAM INCANDESCENT LAMP COMPANY, West and Bethune streets, New York city, is calling attention to the new "Mill type" Sunbeam lamp. This lamp possesses a filament which has more than one complete turn or coil which equals the standard oval anchored-filament type for life and candle-power maintenance on the same current consumption. The Western Electric Company is the general sales agent for the Sunbeam incandescent lamp.

THE CHAPMAN VALVE MANUFACTURING COMPANY, Indian Orchard, Mass., is distributing a handsomely printed catalogue containing a partial list of customers using valves for high and low pressure and superheated steam in power plants for manufacturing, lighting and power purposes. This company builds valves in sizes from one-quarter inch to seventy-two inches in diameter, operated by hand or by electric or hydraulic power.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., manufacturer of wireless clusters, has issued a new catalogue describing a number of new forms of wireless clusters which it has recently placed on the market. The catalogue contains thirty-two pages—double the size of the company's former issue. This catalogue, which is an evidence of the growth of the Benjamin Electric Manufacturing Company, will be sent upon application.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36 West Jackson Boulevard, Chicago, Ill., has recently equipped a private branch exchange in the high school at Topeka, Kan., for the Topeka Independent Telephone and Telegraph Company. The subscribers' lines for the branch exchange are supplied with current from a local installation of dry batteries. The equipment consists also of a complete arrangement for incoming and outgoing trunk circuits.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, Ill., announces that the Kaisling protector has been ordered for the Independent Telephone Company, at Dixon, Ill. The new Dixon exchange will be one of the most modernly equipped exchanges in the country. The Stromberg-Carlson Telephone Manufacturing Company has the contract for the equipment and has ordered the Kaisling protector for the main office. The initial installation is 1,000 pairs.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY, 91 Liberty street, New York, is distributing a circular calling attention to the phonoscopic or electric detector. This detector or test set is a unique device for the use of station managers or others interested in electric light work, for apprising themselves of the condition and operation of dynamos and station apparatus. It can be connected to an electric lamp socket at any point in the wiring system. It is claimed that this instrument is to the manager or inspector of the central station what the stethoscope is to the practising physician.

THE PHOENIX GLASS COMPANY, New York city, is distributing a very attractive catalogue giving outline diagrams and dimensions of the various forms of inner globes for arc light service. The catalogue is accurately indexed, and the method of presentation is such that one gets very readily an idea of the general conformation of the various products. In addition to the excellent arrangement of the subject matter, the catalogue is handsomely printed, the illustrations standing in bold relief against a very pleasant half-tone background.

THE SPRAGUE ELECTRIC COMPANY, 527 West Thirty-fourth street, New York city, has published a handsome catalogue descriptive of direct-current motor equipment for printing-presses. This is designated as bulletin No. 221. Following some interesting literature concerning electric power in the printing and allied trades, there is a description of motor applications. This takes up in detail chain drive, gear drive, direct-connected outfits and friction drive. The various types of motors are then described, the whole work being carefully and elaborately illustrated. These illustrations include motor equipments, controllers, rheostats and belting and other auxiliaries.